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CONFERENCE PAPER

STATISTICAL INFORMATION ON FOOD-BORNE DISEASE IN EUROPE MICROBIOLOGICAL AND CHEMICAL HAZARDS

WHO

Overview

Foodborne disease caused by microbiological hazards is a large and growing public health problem. Most countries with systems for reporting cases of foodborne diseases have documented significant increases over the past few decades in the incidence of diseases caused by micro-organisms in food, including Salmonella spp., Campylobacter jejuni, Listeria monocytogenes or E. coli O157 among others.

Chemicals are a significant source of foodborne diseases, although effects are often difficult to link with a particular food. Chemical contaminants in food include natural toxicants such as mycotoxins or environmental contaminants such as dioxins, mercury, lead, and radionuclides. Food additives, pesticide and veterinary drugs are widely used too and it is essential to assure that these uses are safe.

Surveillance of foodborne disease and food contamination monitoring are essential tools for risk assessment. For this reason main efforts are directed to the development of adequate methods of surveillance of foodborne diseases and food contamination monitoring to provide the necessary data for quantitative microbiological and chemical risk assessment.

This paper presents both data on foodborne diseases in the European Region and information on chemical contaminants, additives and residues in foods that may have an adverse impact in health. Future directions to prevent both microbiological and chemical hazards are discussed.

MICROBIOLOGICAL HAZARDS

1. Introduction: Sources of information on foodborne diseases in the European Region

The main official information on foodborne diseases from the member states of the WHO European Region has been collected by the WHO Surveillance Programme for Control of Foodborne Diseases in Europe. This Programme was launched 20 years ago as a result of the international awareness of the socio-economical impacts of the increase of foodborne disease. Currently there are 50 countries participating in this Programme. The Programme is coordinated by the BgVV, FAO/WHO Collaborating Centre in Berlin, and the WHO European Centre for Environment and Health in Rome, of the Regional Office for Europe, is responsible for the overall management.

Data and information provided by the participating countries include: general information on their surveillance systems, statutory notification (case reporting) and reports of epidemiologically investigated outbreaks. In many countries of the Region, surveillance of foodborne diseases is based primarily on statutory notifications without further laboratory confirmation or closer epidemiological investigations.

The large differences existing in the state of development of the participating countries' surveillance systems makes it difficult to compare figures between participating countries.

Remarkable accomplishments have been achieved by the WHO Surveillance Programme during the last 20 years, including the introduction of harmonised definitions and standardised codes, which are used by many of the participating countries. Additionally the programme has developed a questionnaire to be used when reporting an incident and which is available in several languages. Standardisation has been a major step towards improved reporting, and the programme has been providing valuable information and data for hazard identification and trend analysis in the Region.

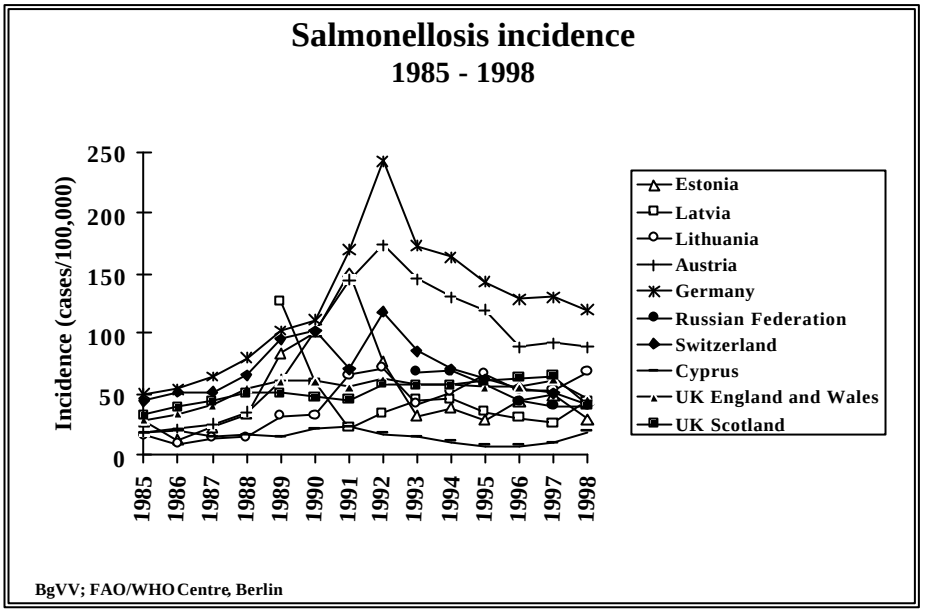
2. Incidence of foodborne diseases

Statutory notifications vary considerably within the WHO European region. Incidence rates of foodborne diseases are not comparable because national reporting, definitions and diagnostic methods are different among the participating countries. This is aggravated by the level of under-reporting; only 1-10% of cases comes to the knowledge of the official agencies and the extent of under-reporting varies from country to country.

Salmonellosis is still the most frequently reported foodborne disease in the region, and in most countries notification of this disease is reliable. Incidences of salmonellosis in the region have not shown a clear geographical pattern, however, there are some temporal trends. Since 1985, there has been a tremendous increase in the incidence of salmonellosis in many countries, with a peak being reached in 1992, or even earlier in some countries such as Latvia and Lithuania (Figure 1).

Retrospectively, it can be stated that there was an epidemic caused by *Salmonella* Enteritidis, but since then the incidence of salmonellosis has decreased, due to the control measures implemented and to a greater awareness of the risk among the public.

Figure 1:



In other countries of the region such as Czech Republic or Hungary, the greatest incidence of salmonellosis appears after a timelag, between 1995 and 1997, and in few others the incidence of salmonellosis is still increasing. In some of the new Eastern European countries and in particular countries of the former Soviet Union (USSR), including the Central Asiatic Republics, the reported cases of salmonellosis have been relatively low or even decreasing from 1993-1998. This may not necessarily reflect a real decrease of the incidence of salmonellosis but rather that the surveillance systems in these formerly centralized USSR countries are not yet fully developed combined with the fact that in some of them the economic situation prevents the population from going to the primary health care services.

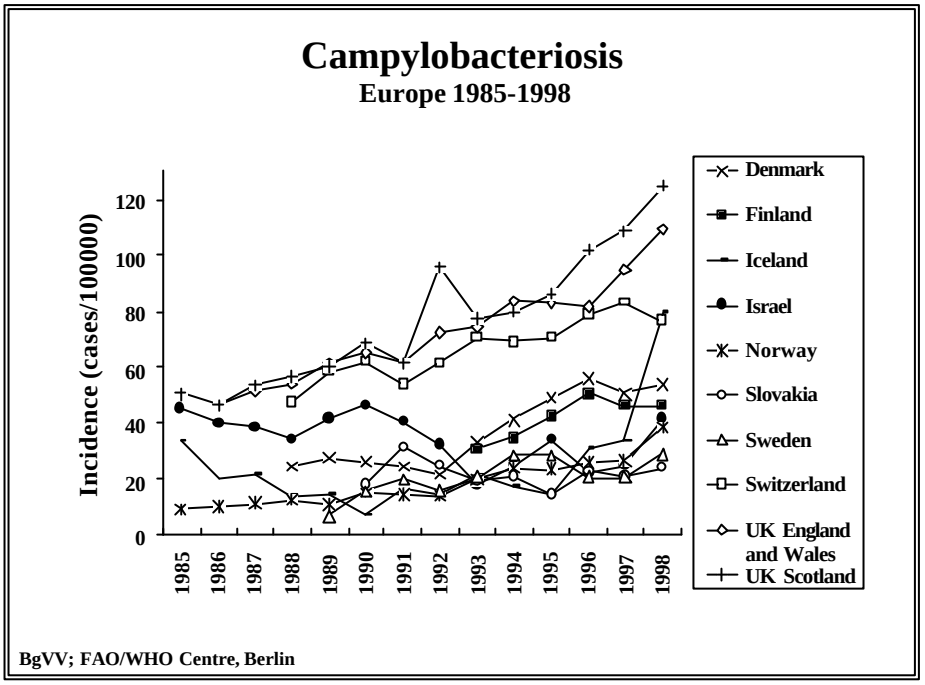
S. Enteritidis is the most frequent serotype found in all countries reporting, with the exception of Cyprus, and Ireland, where *S.* Typhimurium is the most common serotype. The average ratio of cases of *S.* Enteritidis to *S.* Typhimurium in the region during the early 1990s was 3:1 and currently is of 7:1. Other serotypes frequently reported in the European region include *S.* Infantis, *S.* Hadar , *S.* Virchow, and *S.* Blegdam. These serotypes are also related to foodborne disease.

While the incidence of S. Typhimurium has been decreasing over time since the 1980s, the frequency of reported multi-resistant S. Typhimurium DT-104 has been increasing during the '90s, particularly the strains showing the typical penta-resistance pattern to ampicillin, chloramphenicol, streptomycin, sulfamethoxazol and tetracycline.

Reports of campylobacteriosis' cases have been continuously increasing in the region since 1985, and currently is the most common gastrointestinal pathogen in many countries, including the Netherlands, England and Wales, Scotland, Finland, Denmark, Norway, Sweden, Iceland, Ireland and Switzerland (Figure 2). In several countries it is still unclear whether this observed rise could be attributed to a real increase in incidence, or to an improvement in diagnosis, or to

both. Most reported cases of campylobacteriosis occur sporadically, as single cases, or small family outbreaks, and are generally caused by *Campylobacter jejuni*.

Figure 2:



Despite the incidences of zoonotic diseases such as brucellosis, trichinellosis or hydatidosis being in general rather low in some areas of Europe, these diseases are still endemic in many areas. Brucellosis is prevalent in many Mediterranean and Eastern countries, although there has been a continuous decreasing tendency in most of them. The highest incidences of hydatidosis have been reported by the Central Asiatic Republics and the largest incidence of trichinellosis has been reported among the non-Muslim populations in the Balkan region. Trichinellosis cases reported in these areas are usually due to the consumption of products from infested boars and domestic pigs slaughtered and processed at home, without meeting the required sanitation controls.

In addition, food intoxications such as botulism remain relevant in Eastern Europe and these are frequently related to traditional ways of food preparation at home. Most of the cases reported have been associated with the consumption of home-canned meats and vegetables, and fish or meat that were smoked or cured at home. To prevent these dangerous and even fatal diseases, it is necessary that consumers in these areas are made aware of the risks, and to educate consumers in food safety matters and in how to process foods properly.

Cases of Listeria monocytogenes are only reported by few countries, and higher incidences are reported by countries in which communication is mandatory such as France. Also few countries provide information on numbers of *E. coli* O157 infections or haemolytic uremic syndrome (HUS) cases. Considering the large differences in the reporting systems among the countries it is still difficult to make an analysis of trends for Listeriosis or for *E. coli* O157 infections and HUS cases.

Variant Creutzfeldt-Jakob disease (vCJD) was first reported in 1996 in the UK. In contrast to the traditional forms of Creutzfeldt-Jakob disease (CJD), vCJD has affected younger patients, has a

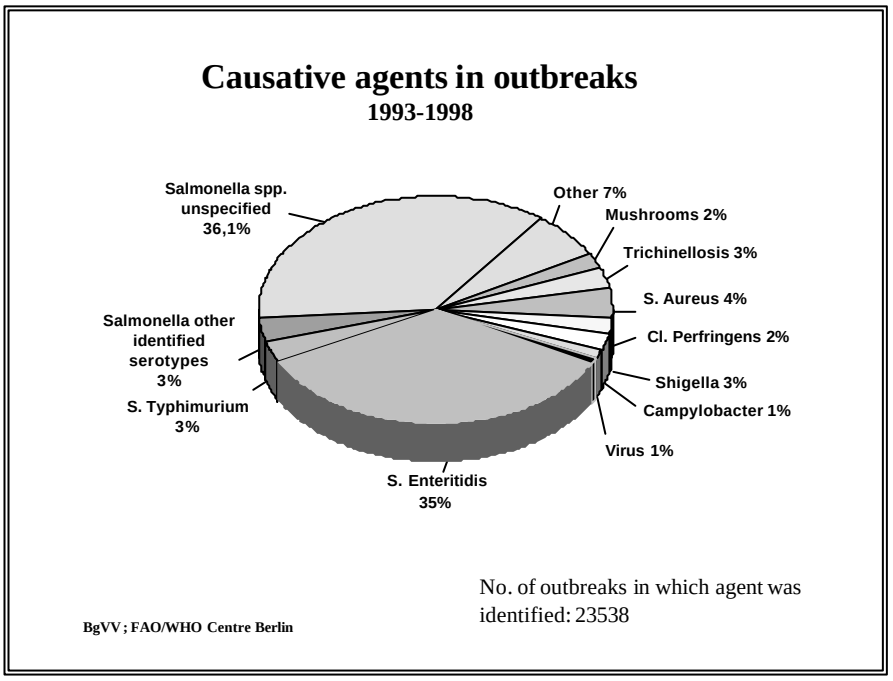
relatively longer duration of illness and is strongly linked to exposure, probably through food, to Bovine Spongiform Encephalopathy (BSE). From October 1996 to early June 2001, 95 cases of vCJD were reported in the United Kingdom, three in France and a single case in the Republic of Ireland. Insufficient information is available at present to make any well-founded prediction about the future number of vCJD cases.

3. Data and information from investigated outbreaks

3.1. Causative Agents

More than 30,000 investigated outbreaks involving a total of 391 383 cases have been reported by 42 countries to the WHO Surveillance Programme for Control of Foodborne Diseases in Europe from 1993-1998. The causative agent was identified in approximately 23,538 outbreaks (Figure 3). Salmonella ssp is still the most frequently reported causal agent of the outbreaks in the European region, being responsible for 77.1 % of outbreaks. Of these, more than one third were confirmed to be caused by S. Enteritidis. Other causative agents identified in the investigated outbreaks included Staphylococcus aureus (4%), Trichinella (3%), Shigella (3%), Clostridium perfringens (2%), toxic mushrooms (2%), Campylobacter (1%), viruses (1%) and other (7%). Despite the low average percentage of outbreaks attributed to viruses in the European Region several countries such as Ireland, Finland, Switzerland or United Kingdom have reported that viral agents were involved in a large percentage of the outbreaks. Currently in the UK the small round-structured viruses (SRSVs) are the major cause of general outbreaks of gastroenteritis (although outbreaks of SRSV are not only spread by food). The fact that only a 1% of outbreaks reported in the European Region were attributed to viral sources is due principally to the lack of an infrastructure for a proper routine diagnosis in many of the participating countries.

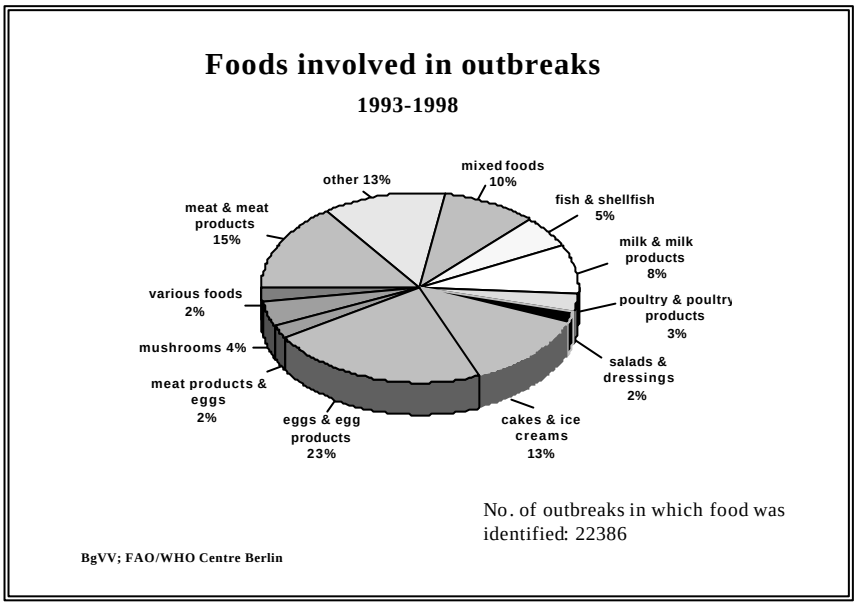
Figure 3:



3.2 Foods Involved in the investigated outbreaks

In the 22 386 investigated outbreaks in which food was identified, eggs, egg containing foods, mayonnaise, and products containing eggs, such as sweets and cakes, were responsible for almost 40% of the outbreaks (Figure 4). The effect of the high number of *Salmonella*-induced outbreaks in this frequency distribution is clear. Meat and meat products were involved in 15% of outbreaks, mixed foods in 10%, milk and milk products in 8%, fish and shellfish in 5%, mushrooms in 4% and poultry in 3%. Focusing on the outbreaks of *S.* Enteritidis, more than 75% of the investigated outbreaks were directly related to the consumption of insufficiently cooked eggs, or foods containing raw eggs, such as ice creams or cream-filled pastries.

Figure 4:

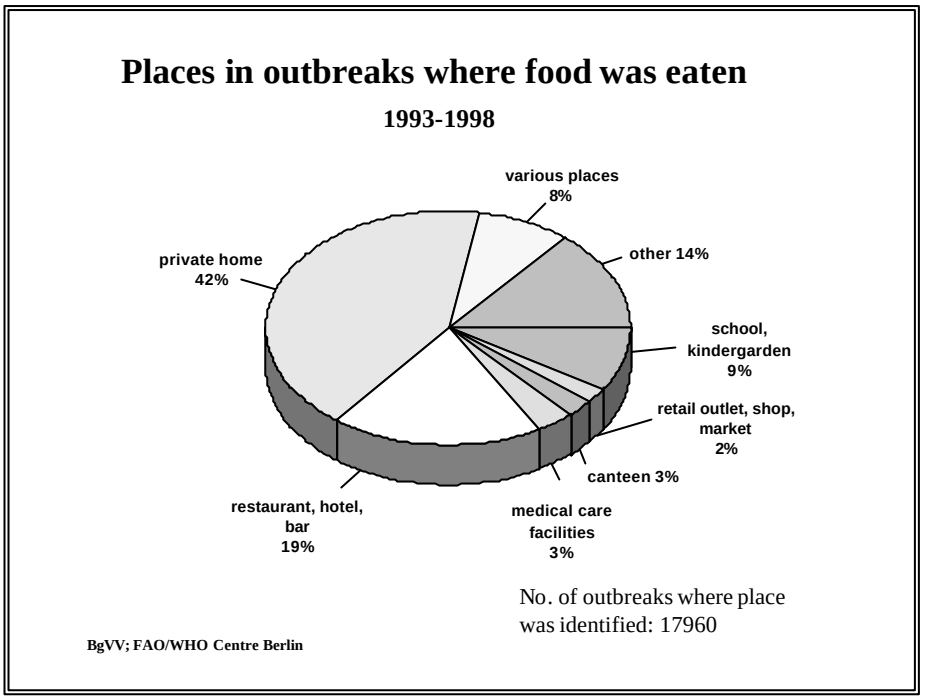


3.3. Places where outbreaks occur

The private home is the single location where most foodborne outbreaks occur; more than 40% of them (Figure 5). Outbreaks associated with mass catering kitchens in restaurants, cafeterias, catering services accounted for 22% of the outbreaks, schools, kindergartens and homes for children 8.7%, hospitals 3%, retail shops 2%, institutions 1.5%, homes for elderly 1% and other/various places accounted for the remainder number of outbreaks.

The frequency distribution of the places where the outbreaks occurred varies throughout the European region, depending mostly on differences in eating habits. In Poland, for example, 57% of outbreaks occur at home and these are frequently related to the preparation of dishes containing raw eggs contaminated with *Salmonella*. In Hungary, where up to 83.5% of outbreaks occur at home, many of these outbreaks are caused by intoxication from wild mushrooms cooked in the home. On the other hand, in the Netherlands, for example, the largest percentage of outbreaks is reported to occur outside the home, in restaurants, hotels or cafeterias, and an important percentage of these outbreaks is due to the *Bacillus cereus* in rice dishes served in Chinese restaurants. In Switzerland the relatively low incidence of outbreaks occurring at home could be a consequence of the consumer education programmes launched in 1991 to reduce *Salmonella* infections.

Figure 5:

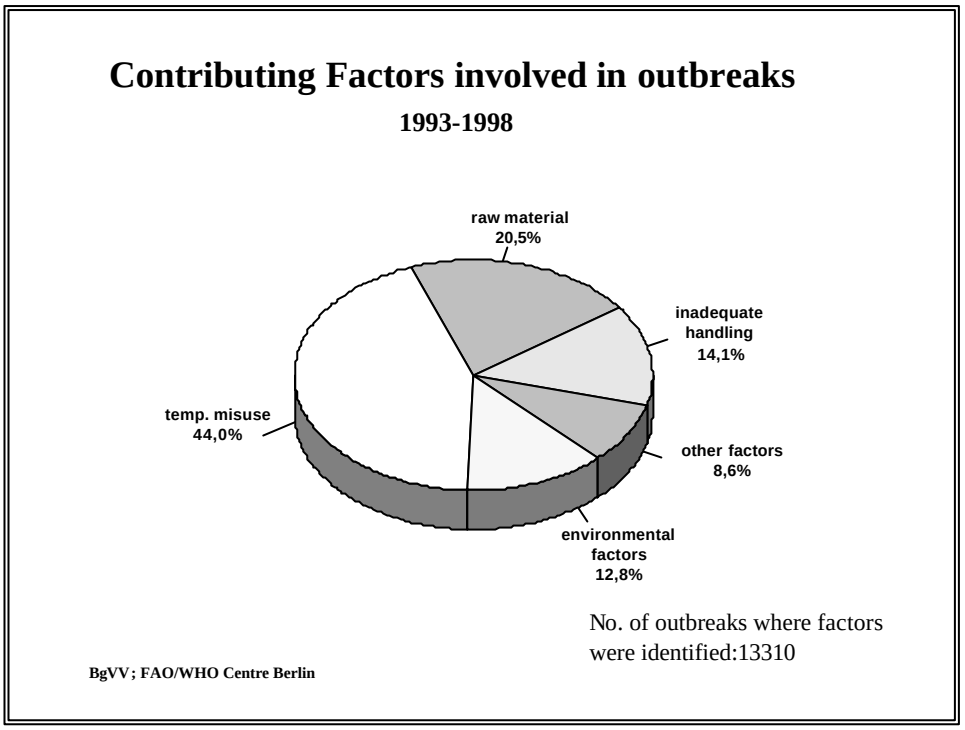


3.4. Factors contributing to the outbreaks

Information on the factors contributing to the outbreaks is limited. These were identified in only a 72% of the outbreaks for which information about the contributing factors is available. From the approximately 18,000 investigated outbreaks in which the contributing factors were identified, the main contributing factor categories in order of importance are: temperature misuse, use of inadequate raw materials, environmental factors, inadequate handling and other (Figure 6). Frequently, more than one contributing factor is involved in an outbreak.

Temperature misuse was involved in 44% of the outbreaks investigated. In this category, factors such as inadequate refrigeration and inadequate cooking, reheating or hot holding, accounted for a similar percentage. This distribution varies according to geographical location. For example, in Mediterranean Countries the main contributing factor is inadequate refrigeration, whereas in the Northern countries, main contributing factor is the inadequate cooking, reheating or hot holding.

Figure 6:



Use of inadequate raw materials was reported in 20,5% of the outbreaks. These raw materials were either chemically or microbiologically contaminated, or contaminated ingredients (such as spices), or toxic mushrooms. Inadequate handling was reported in 14,1% of the investigated outbreaks, mostly due to cross-contamination, inadequate processing, insufficient hygiene, and the re-use of leftovers. Several environmental factors were involved in 12,8% of the outbreaks investigated. In this category, contamination by personnel was the most frequently reported contributing factor, followed by contaminated equipment, and use of inadequate rooms. The identification of this type of contributing factors in an outbreak is essential for the implementation of adequate measures for the prevention of foodborne diseases by the food industry and the catering sectors (e.g. HACCP plans) and to provide the grounds for consumer's education.

4. Future directions

In order to set priorities for future activities of national food safety programmes it is necessary to improve the evaluation of the burden of foodborne disease. In this context, surveillance of foodborne diseases should be given a high priority in the development of food safety infrastructure. Available surveillance data suggest that the frequency of foodborne disease is increasing, but disease incidence and cause-and-effect relationships should be documented.

There is a need to develop and coordinate a global approach to strengthen surveillance and to harmonize reporting systems at national, regional and international levels. In the near future WHO will initiate a Global Strategy for surveying foodborne diseases by urging Member States to set up laboratory-based systems covering both outbreaks and endemics and for monitoring microbiological and chemical contamination.

The laboratory base should be strengthened through international laboratory networks and the epidemiological basis for monitoring disease incidence through sentinel sites for foodborne

disease should be developed, especially in developing countries. Additionally there will be established common, internationally agreed formats for harmonized data collection and determine the minimal data requirements for future food safety initiatives in the regions. WHO is also planning to develop a web-based system to collect, report and communicate data from surveys conducted in Member States.

Building capacity for public health laboratories to conduct laboratory-based surveillance and for conducting epidemiologically-based surveillance are important global public health objectives. When requested by Member States, support for capacity building for data collection and survey system will be provided.

The new challenge in the surveillance area is to provide data for microbiological risk assessment, in particular for hazard identification and hazard characterization. To conduct risk assessments and implement risk management strategies to prevent foodborne diseases it is necessary to develop different structures and systems at national, regional and international levels. Main efforts should be directed towards the development of adequate methods of surveillance of foodborne diseases and food contamination monitoring, as well as the linkage between these, to provide the necessary data for quantitative microbiological risk assessment. Relevant typing systems, which could potentially be used to link human isolates to food isolates and thereby contribute to the evaluation of disease fractions attributable to different food groups, should be further investigated.

The implications of introducing risk-based strategies based on optimised surveillance data should be investigated. In general, these developments would have, as a necessary prerequisite, an integrated and interdisciplinary approach founded on improved collaboration between the sectors dealing with foodborne disease registration and food safety within the health area.

The improvement of the methods for risk assessment for microbiological hazards in food are necessary in order to provide accurate, globally representative bases for standard setting by Codex. It is essential that all countries in the European Region participate effectively in the development of Codex standards. To do so, countries must develop and/or improve their survey and monitoring methods for food contamination and intake and use these data to establish achievable international limits and recommendations for hazards in food.

CHEMICAL ASPECTS

5. Introduction

The contamination of food by chemical hazards is a major public health concern in Europe. The use of various chemicals, such as food additives, pesticides, veterinary drugs and other agro-chemicals can also pose hazards if such chemicals are not properly regulated or appropriately used.

Information on chemical food contamination in Europe is variable and usually not recorded in monitoring programmes. In Central and Eastern Europe food contamination arises largely from industrial contamination of air, soil and water – whether from mining and smelting activities, the energy sector, the agricultural industry or dispersal of hazardous and municipal waste. Contamination of food items usually occurs in these “hot spots” rather then contamination of food items throughout the whole country. One of these hot spots is certainly the Aral Sea Area, which is considered one of the serious examples of a natural area polluted by human activities. For almost 30 years the use of water for the irrigation of cotton monoculture and the heavy

application of insecticides, pesticides like dichlorodipheniltrichloroethane (DDT), aldrin, dieldrin and Lindane, herbicides and defoliants brought not only ecological, economic and social insecurity, but created also a serious critical situation for the health of the local population. In this region, which includes the Autonomous Republic of Karakalpakstan in Uzbekistan, the District of Kzylorda in Kazakhstan and the District of Dashovuz in Turkmenistan, high level of DDT and other organochlorine compounds such as alfa- and beta-Hexachlorocyclohexanes (HCH), but also Tetrachlorodibenzo-p-dioxins appeared in soil, water and air as well as in every biological level of the food chain, notably in humans. A broad panel of analytes (more than 60 organochlorine and congener specific dioxins, furans and polychlorinated biphenyls) was measured in breast milk samples and in a variety of adult and infant foods collected in Southern Kazakhstan. A pilot study recently carried out in the Autonomous Republic of Karakalpakstan in Uzbekistan by Dutch scientist has confirmed these findings, showing that perinatal exposure to such environmental pollutants in the Aral Sea Area might be the principal cause of rates of anaemia, kidney and liver diseases, respiratory infections, allergies, cancer, tuberculosis higher than in other States of the former USSR. Other chemical hazards, such as naturally occurring toxicants, may arise at various points during food production, harvest, storage, processing, distribution and preparation. Furthermore, accidental or intentional adulteration of food by toxic substances has resulted in serious public health incidents. For example, in Spain in 1981-1982, rape seed oil denaturated with aniline killed more than 2000 people and disabled another 20 000, many permanently. In this case, the agent responsible was never identified in spite of intensive investigations.

Over the past 50 years, the widespread introduction of chemicals in agriculture and in food processing has resulted in a more abundant and arguably safer food supply. To protect consumers, most governments have adopted a risk assessment paradigm to scientifically estimate the potential risk to human health posed by chemicals in food. While risk assessment methods have been to a great extent harmonized, risk management approaches will necessarily vary depending on whether the chemical is intentionally added to the food supply or is present as the result of inadvertent or unavoidable contamination. In addition, the choice of a risk management option may vary among countries depending on their desired level of health protection and technical, economic, socio-cultural and other factors. In a number of cases, these differences have resulted in disruption of international food trade.

6. Food Additives

Food additives comprise a large and varied group of chemicals, which have a long history of use or are thoroughly tested to assure their safety. They are added to food to improve keeping quality, safety, nutritional quality, sensory qualities (taste, appearance, texture etc.), and certain other properties required for processing and/or storage. Food additives are evaluated to assure that these substances are used safely, which includes the precaution that a food additive should be used at the minimum level to achieve its technological effect.

7. Veterinary Drug Residues

Veterinary pharmaceuticals have been a key element in increasing the production of animal derived foods. Vaccines and therapeutic drugs are essential to protect the health of confined animals, which are under more stress and are more at risk for communicable diseases. Antibacterial drugs are also given to animals in less than therapeutic doses to promote weight gain and to improve feed efficiency. Again, conditions for their safe use must be established before these substances are marketed. It should be noted that the use of antibiotics in this way has contributed to problems with antibiotic-resistant micro-organisms in humans. Therefore, some countries are now banning in animal production the use of certain class of antimicrobials that are essential for human use. Furthermore, the use of hormonal anabolic agents in meat

production has proven controversial and an international consensus on these uses is currently lacking.

8. Pesticide Residues

Like other intentionally added substances, pesticides are evaluated and conditions for safe use, including maximum residue limits, are established before they are introduced in agriculture. Because of their inherent toxicity, the application of good agricultural practices is extremely important when pesticides are employed. In a number of situations, foods have been found to contain high levels of pesticide residues, for example, when the crops had been harvested too soon after applications of pesticides or when excessive amounts of pesticides had been applied.

In a recent study published by the EU, the number of samples for which residues of pesticides exceeded their corresponding maximum residue limits was about 4.3%. While this increasing trend in the number of violative samples is worrisome, the more significant public health concern is for high residues of certain pesticides, which may produce acute adverse health effects. In particular, developmental and reproductive effects are of concern because these can be caused by single exposures to high levels of pesticides.

9. Environmental Chemicals

A number of chemical substances may occur in the food supply as a result of environmental contamination. Their effects on health may be extremely serious and have caused great concern in past years. Serious consequences have been reported when foods contaminated with toxic metals such as lead, cadmium, or mercury have been ingested. For chemicals such as lead, human exposure is truly through multimedia, including air, water, soil and food. Consequently, significant reductions in such exposures will require the coordinated efforts a several government agencies and sectors. On the other hand, exposure to other chemicals, such as mercury, occurs through very limited pathways. Because exposure to mercury, in the form of methylmercury, is mainly through fish, several European countries recommend that vulnerable groups, including pregnant women, limit their intake of certain fish known to contain high levels of mercury.

Dioxins as well as polychlorinated biphenyls (PCBs) are among a group of toxic chemicals known as persistent organic pollutants (POPs). In the environment, dioxins tend to bioaccumulate in the food chain. The name dioxin applies to a family of structurally and chemically related polychlorinated compounds, which are mainly by-products of industrial processes and waste incineration. PCBs were intentionally produced for electrical applications and often contain amounts of dioxins as contaminants. Dioxins and PCBs are found at low levels throughout the world in practically all foods, but especially dairy products, meat, fish and shellfish. A major incident involving elevated levels of dioxins and PCBs in animal derived foods occurred in Belgium as a result of a contaminated ingredient (recycled edible oil) in animal feed. Epidemiological investigation following an industrial accident in Seveso, Italy indicates that acute effects of exposure to high levels of dioxins include skin lesions, such as chloracne, altered liver function and a curious shift in the sex ratio of progeny to favour girls. Long-term exposure is linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions. Chronic exposure of animals to dioxins has resulted in several types of cancer. In June 2001, a Joint FAO/WHO Expert Committee on Food Additives (JECFA) recommended a tolerable exposure to dioxins, which is in the range of current exposure levels estimated in several European countries. However, for most European countries, data from the WHO-coordinated study of levels of dioxin and related compounds in human breast milk suggest that the trend in exposure is downward and that source directed measures have been effective in reducing environmental emissions.

Another environmental pollutant is radionuclides, although emission of these substances is largely limited to industrial accidents. The Chernobyl accident provoked great concern about the health risks to people, but these were mainly limited to people living in the vicinity of the accident and in parts of Europe where deposition occurred. In other parts of Europe and elsewhere, concern focused on contaminated foods from these areas as main source of exposure. In most cases, the estimated average dose acquired from eating contaminated foods only amounted to a fraction of the dose normally received from background radiation. At the present time, food contaminated by radionuclides with long half-lives, such as caesium 137, is the major source of exposure for people living in the Ukraine.

10. Mycotoxins

Mycotoxins, the toxic metabolites of certain microscopic fungi (moulds), may cause a range of serious adverse effects in humans and in animals and have been of growing national and international concern since the 1970s. However, mycotoxicosis has been a major, but unrecognized food safety issue in Europe for several centuries. For example, St Anthony's fire is now known to be caused by a mould present on rye. Animal studies have shown that besides acute effects, mycotoxins are capable of causing carcinogenic, mutagenic and teratogenic effects. Currently several hundred mycotoxins have been identified. Aflatoxin is the most well known and important mycotoxin from an economic point of view. As fungi producing aflatoxin prefer high humidity and temperatures, crops in tropical and subtropical regions are more subject to contamination. Aflatoxins are found in peanuts, maize, tree nuts, and some fruits such as figs. Aflatoxin contaminated animal feed is also of human health concern as it shows up in tissues which are used as human food. This is of particular importance in relation to dairy cows as aflatoxin B in feed is metabolised by the animals and excreted in milk as aflatoxin M.

Other mycotoxins of concern include ergot alkaloids, ochratoxin A, patulin, fumonisin B, and the trichothecenes. JECFA has established very low provisional tolerable intakes for ochratoxin A, patulin, fumonisin B and some of the trichothecenes. In view of their presence in many foods and their stability during processing, mycotoxins must be considered a major public health concern.

11. Marine Biotoxins

Intoxication by marine biotoxins is another problem of concern. In many areas of the world this type of poisoning is a major public health problem, affecting many thousands of people. The most common type is ciguatera, which is associated with the consumption of a variety of tropical and subtropical fish, mainly coral fish, feeding on toxin-producing dinoflagellates, or predatory fish consuming such coral fish. However, as these fish are not often traded internationally, this is not a significant problem in Europe. However, another group of marine biotoxins produces acute intoxication after consumption of contaminated shellfish. Known for centuries, this intoxication occurs throughout the world, including Europe. Toxins causing shellfish poisoning are produced by various species of dinoflagellates. Shellfish feeding on these algae accumulate the toxins, without being affected. The shellfish most often implicated are clams, mussels, and occasionally scallops and oysters. Depending on the symptoms, different types of intoxications have been described as a result of the consumption of contaminated shellfish. These include paralytic shellfish poisoning (PSP), diarrhoeal shellfish poisoning (DSP), neurotoxic shellfish poisoning (NSP), amnesic shellfish poisoning (ASP) and azaspiracid poisoning (AZP). Recent evidence suggests that the warming of the world's oceans has altered the distribution and range of the dinoflagellates.

12. Plant Toxicants

Toxicants in edible plants and poisonous plants that resemble edible plants are important causes of ill health in many areas of the world. Green potatoes and tomatoes contain naturally occurring

toxins and insufficiently cooked legumes may contain toxic substances. In Europe, misidentification of toxic mushrooms is by far the leading cause of illness and death in this category.

13. Bacterial toxins

Several toxins are produced in food as the result of contamination and growth of bacteria. These bacteria include *Staphylococcus aureus*, *Bacillus cereus* and *Clostridium botulinum*. Intoxications caused by toxins of Staphylococcus aureus and Bacillus cereus are not uncommon, but are usually self-limiting. However, botulism is serious and often fatal and specific control measures for this hazard are in place in most countries in the WHO Region of Europe. Another group of bacterial toxins are the biogenic amines, which are formed during fermentation (e.g. cheese ripening, wine fermentation) and decomposition of protein. They include histamine, tyramine, cadaverine, putrecine and others. The main significant food safety hazard is related to this is the formation of histamine in a number of fish species *post mortem* by bacterial activity.

14. Nutritional hazards

While some nutrients can pose a hazard by being present in excessive amounts, e.g. Vitamin A, most nutrients are of concern when they are not present in sufficient amounts in the diet. For foods that are fortified, the proper addition of the nutritional supplement becomes a critical issue for health. For example, if iodine was not present or was insufficient in iodised salt, mental retardation and other adverse effects could result in populations living in areas of endemic iodine deficiency disorders. In addition to iodine deficiency disorders, deficiencies involving several other micronutrients, such as iron, niacin, vitamin A and folic acid, pose serious public health concerns and fortification of foods with these micronutrients is being used in many countries to assure sufficient intakes. Similarly, foods for infants that comprise a significant portion of the diet must be produced with special care to assure that inadvertent deficiencies do not occur. Under these situations, the monitoring of fortified food is an important food safety activity that should be integrated into the existing food control infrastructure.

15. Future Directions

Most governments have been largely successful in protecting the consumer from chemical hazards, both those intentionally added and those occurring as contaminants. However, it is also clear that constant vigilance is essential to maintain this high standard, particularly in regard to sporadic outbreaks caused by illegal activities. The periodic failings of food safety systems to control chemical hazards, point to the need for more effective approaches for ensuring that such events do not occur. Furthermore, when such incidents occur, action must be promptly taken, including rapid and accurate communication with the international community. This has become more important given the increased awareness that terrorist threats to the food supply must be countered by efforts to strengthen prevention and response infrastructure.

With the incorporation of risk analysis principles into the development of international standards, foodborne risks must be characterized more precisely and transparently than has been done in the past. This includes strengthening of the scientific database to evaluate toxic effects, caused by both long- and short-term exposures. Endocrine disruption, neurotoxicity and immunotoxicity are three areas of growing concern. The growing rates of breast cancer in women, testicular cancer in men and brain cancer in children all suggest that further research is needed to rule out the possible contribution of chemicals in food to these diseases.

Research into the potential adverse health effects of chemicals should be accompanied by refinements of knowledge about exposure assessment in order to provide the most precise and accurate assessments of the risks posed by chemical hazards. This also serves to provide the

basis for international harmonization under the World Trade Organization's Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement). Key to this is the strengthening of national capacities to conduct health-oriented, population-based monitoring programmes to assess exposure of populations to chemicals in food and the total diet.

Less developed countries must develop risk assessment and management capabilities to effectively deal with chemical hazards in food. In some countries, existing infrastructures needs to be streamlined and strengthened to achieve a higher level of protection. Some countries still do not have detailed legislation to control chemicals in food or lack food control capacities to enforce such legislation. In less developed parts of Europe, the risks posed by chemicals in food are uncharacterised. Most of these countries have no monitoring capabilities and little information about the dietary exposure of their populations to chemicals in food, such as total diet studies, is available. Therefore, all less developed countries in Europe are encouraged to actively participate in activities of the international organizations, such as the INFOCRIS by the FAO and IAEA and the GEMS/Food-EURO Programme organized by the WHO Regional Office for Europe. Developed countries should offer technical and financial assistance in establishing and strengthening basic chemical assessment capabilities in less developed countries in collaboration with international organizations.

16. Recommendations for the Pan European Conference on Food Safety

16.1 European countries should promote and strengthen surveillance of foodborne diseases and food monitoring contamination systems and the inter-linkage between these. Developing or newly established countries in the Region should be assisted to establish their surveillance-monitoring systems and their laboratory capabilities. Intersectorial co-operation and coordination between sectors dealing with foodborne disease and contamination at the national and international level is essential

16.2 Further collaboration between the countries in the region to improve and harmonise surveillance systems, outbreak investigation, reporting systems and diagnostic methods should be encouraged. Improvement of the quantity, quality and frequency of data reporting at national level and to the WHO Surveillance Programme for Control of Foodborne Diseases in Europe.

16.3 Promote the collection of food microbiology data for risk assessment to assist the Joint FAO/WHO expert consultation on risk assessment of microbiological hazards in food (JEMRA). The outcome of such international risk assessments, as well as the methodology used for these, should be used also at national level.

16.4 Countries should improve their ability to perform risk assessments of chemicals in the food supply, and, in particular, to conduct unbiased monitoring and other studies to determine levels and trends of chemicals in food.

16.5 Countries across Europe should harmonize their data reporting formats for chemical contaminants in food as the first step in developing consistent and comparable assessments for both health and standards-setting purposes, e.g. Codex. In this regard, the GEMS/Food data structure should be considered as the default if no other format is available.

16.6 Countries should undertake total diet studies to assess dietary and other exposures to toxic chemicals by the overall population as well as vulnerable groups such as children. The consumption part of such studies will contain valuable information which will be useful also in microbiological risk assessment. In cases of localized contamination, duplicate diet studies

should be conducted to assess possible exposure to unacceptable levels of toxic chemicals through food.

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