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Examples of comprehensive and integrated approach to risk analysis in the food chain - experiences and lessons learned.

An integrated approach to food safety covering the whole of the food chain and beyond: Sweden, Finland and the European Commission

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Overview

This paper explains the need and application of a holistic approach to risk analysis and food safety throughout the food chain, at national, regional and international level. Responsibilities of those who produce, process and trade food are explained, with details of those responsibilities. Tackling problems at source using a preventive and integrated approach is emphasised and successful examples (such as the control of salmonella in poultry in Sweden and Finland) are explained. The paper concludes by recognising the need to develop systems for detecting emerging risks, as they arise, at any point in the food chain.

1. Introduction

It is difficult to make a firm assessment of the current situation about foodborne disease and the trends because of widespread under-reporting of these cases. However, many countries with systems for recording foodborne disease have reported significant increases in the incidence of diseases caused by pathogenic micro-organisms in food over the past few decades. As many as one person in three in industrialised countries may be affected by foodborne illness each year, resulting in deaths and human suffering and economic losses running into billions of US\$¹. In Europe, bovine spongiform

¹ A Global WHO Food Safety Strategy, WHO Geneva, 2001 and Opinion of the Scientific Committee on veterinary measures relating to public health on Food-borne zoonoses. 12 April 2000, European Commission.

encephalopathy (BSE - 'mad cow disease') and episodes of dioxin contamination of foods have resulted in a loss of consumer confidence in the safety of some foods on the market, with severe economic consequences. It is vital that consumer confidence in the food supply be restored and maintained. Consumers should be able to assume that all food offered for sale is safe. Nowadays in Europe there is also greater consumer interest in animal welfare aspects of food production – not only ethical concerns, but also the possible impact on the quality and safety of foods of animal origin.

At the *Food Chain* conference², organised in Uppsala during the Swedish Presidency of the European Union (EU), the vision for future food production was summarised as '*Safe, sustainable and ethical*'. Although much progress has been made in recent decades and some claim that 'our food has never been safer', those involved in trying to ensure the safety of the food supply should recognise that there is still a long way to go before that goal is reached.

2. Holistic approach to food safety – the whole of the food chain and beyond

Previously, food control often concentrated on the examination of end products and inspection of food processing and catering establishments. However, in recent decades there has been a growing awareness of the importance of an integrated, multidisciplinary approach, considering the whole of the food chain (and in some cases beyond what is conventionally regarded as the food chain). Many food safety problems have their origins in primary production and one result of the change in approach is a much greater awareness of the need for better control on the safety of animal feed, an area which until fairly recently had received scant attention from those responsible for food safety. In recent years, much stricter control on animal feed has been introduced in the EU and the Codex Alimentarius Commission (CAC) has established an *ad hoc* Task Force on Animal Feeding.

Environmental pollution, for example with persistent chemicals such as mercury, cadmium, PCBs and dioxins, can lead to food safety problems. Another result of the change to a more holistic approach is recognition of the need for much closer contact and collaboration between the food control authorities and those responsible for environmental protection. Coupled to this there is now a greater emphasis on source-directed preventive measures, for example, measures to prevent mycotoxin formation, both pre- and post-harvest. Some examples of this preventive approach are given below.

2.1 Application of risk analysis in the food safety area

Towards the end of the last century, there was a paradigm shift in the food safety area with the introduction of a risk-based approach. One reason for this was the advent of the World Trade Organisation Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement). This Agreement requires Member States (MS) to base their food safety measures on risk assessments, taking into account risk assessment techniques developed by the relevant international organisations – the CAC in the case of food safety. However, Article 5.7 of the SPS Agreement allows MS to take provisional measures, where relevant scientific evidence is insufficient.

In order to stimulate the application of risk analysis principles in food safety work, FAO and WHO jointly organised a series of expert consultations on the different components of risk analysis – risk assessment, risk management and risk communication³. The recommendations from those Consultations

² Web site: www.foodchain.org

³ FAO/WHO Expert Consultations (1) FAO/WHO Application of risk analysis to food standards issues. Report of the Joint FAO/WHO Expert Consultation 1995, Geneva. (2) FAO/WHO Application of risk management to food safety matters, Report of the Joint FAO/WHO Expert Consultation 1997, Rome. (3) FAO/WHO Application of risk communication to food standards and safety matters. Report of the Joint FAO/WHO Expert Consultation. 1998, Rome.

have been used as the starting point for the introduction of risk analysis principles into the Codex system. They have also been used by many government agencies in developing food safety risk management.

There should be a functional separation of risk assessment and risk management in order to ensure the scientific integrity of the risk assessment. However, risk analysis is an iterative process and interaction between risk managers and risk assessors is essential for the practical application of risk analysis. This has been recognised in the proposal for the new European Food Authority (EFA)⁴, which will have responsibility for risk assessment in all matters having a direct or indirect impact on food safety. The Authority will work closely with the European Community bodies that have responsibility for risk management (the Commission, the Council and the Parliament). In line with the holistic approach to food safety, the mandate of the Authority will cover the whole 'farm-to-fork' continuum.

A risk-based approach to food safety risk management implies that food control resources should be directed towards problems that pose the largest threats to health and where the potential risk reduction is large - in relation to the resources used. In order to make priorities more risk-based, much better systems for follow up and reporting on food-related diseases are needed and better international co-operation in this area. WHO is making a major effort to improve the current situation, but is, of course, dependent on the active co-operation of national agencies.

2.2 Producers, processors and traders

Responsibility for food safety, HACCP-based in-house control

It is fundamental that all involved recognise that *primary responsibility for food safety lies with those who produce, process and trade in food*. This responsibility covers the whole food chain – farmers and their suppliers, fishermen, slaughterhouse operators, food processors, transport operators, wholesale and retail traders, caterers, etc. It is their duty to ensure that the food they produce and handle is safe and satisfies the relevant requirements of food law. And they should verify that such requirements are met. They should operate according to the principles of Good Agricultural/Hygienic/Manufacturing Practice. Food production, processing and other handling operations should be analysed with a view to identifying hazards and assessing associated risks. This should lead to the identification of critical control points and the establishment of a system to monitor production at these points (i.e. the Hazard Analysis and Critical Control Point – HACCP approach). The introduction of HACCP-based in-house control may be difficult in small and medium-sized enterprises with limited knowledge, experience and resources and is probably best achieved by collaboration between the food industry and trade, education and training organisations and the supervisory authorities. The CAC and its parent organisations, WHO and FAO, have produced useful guidelines and training and information materials⁵ on the application of HACCP in food control.

Food hygiene in catering establishments

In many countries there are indications that a large proportion of cases of foodborne disease are due to poor hygienic practices in restaurants and other commercial catering establishments. Those responsible for the operation of such establishments must ensure that their personnel receive adequate training in food hygiene and that they work in such a way as to be able to guarantee the safety of the food they serve. Manuals and/or handbooks based on HACCP-principles should be developed to assist in such training.

⁴ COM (2000) 716 final: Proposal for a Regulation of the European Parliament and of the Council laying down the general principles and requirements of food law, establishing the European Food Authority, and laying down procedures in matters of food. COM (2001) 475 final: Amended proposal for a regulation of the European Parliament and of the Council laying down the general principles and requirements of food law, establishing the European Food Authority, and laying down procedures in matters of food safety.

⁵ For example, Strategies for implementing HACCP in small and/or less developed businesses (WHO/SDE/PHE/FOS/99.7), Guidance on regulatory assessment of HACCP (WHO/FSF/FOS/98.5)

Traceability

The traceability of feed, food-producing animals and food should be established at all stages of production, processing and distribution. In the EU this requirement already exists for some foods and it will apply generally when the new European Community Regulation laying down the general requirements of food law⁶ is finalised and comes into force. Traceability is important for at least two reasons. Firstly, to enable unsafe foods to be traced through the food chains so that the source of the problem can be identified and dealt with. Secondly, to ensure fair practices in the food trade, for example, the labelling of organic foods, foods consisting of or prepared from genetically modified organisms, and foods fulfilling certain religious (such as Halal or Kosher) criteria. A good system for tracing food throughout the production, processing and distribution chain is also valuable for the food industry and trade, since recall of faulty products can be more effective.

2.3 Supervisory authorities

The main task of the *supervisory authorities* is to lay down food safety standards and to ensure that the HACCP-based internal control systems operated by food producers, processors and traders are appropriate, validated and operated in such a way that these standards are met. In addition, the authorities should carry out certain direct control activities to ensure compliance with legislation and they should also provide information and advice on a wide range of food-related matters that can affect human health.

Organisation

In recent years, the organisation of food control at the national level in many European countries has been changed and a single agency has been given responsibility for the whole of the food chain from 'farm to fork'. Such a system has many advantages and is to be recommended. If responsibility is, nevertheless, divided between two or more agencies at the national level it is vital that there is very close co-ordination between them. Similarly, if responsibility for food control is divided between central and local authorities, then it is important that the central authorities not only advise and inform the local authorities on food control matters, but also have the power to co-ordinate and audit their work.

Transparency

The work of the supervisory authorities should be carried out in a transparent manner, with open communication with consumers, producers, processors, traders and other interested parties. One effective way of increasing compliance with food legislation is to make the results of food control activities public. This applies of course to inspection reports and results of control analyses carried out by the supervisory authorities. In some countries the results of inspections of catering establishments and shops are posted in the premises or published in the media and this no doubt affects consumers' choice of shops and restaurants to visit and, encourages compliance. In countries where responsibility for food control is divided between different authorities, e.g. central and local authorities, the results of audits carried out by national authorities on the food control work carried out by local authorities should be made public, as they are in the UK, for example. The results of the European Commission's Food and Veterinary Office inspections/audits of the food control activities carried out in the Member States are made public and are available on the Internet⁶.

2.4 Consumers' responsibilities

Responsibility for food hygiene in the home and for ensuring that food storage and preparation recommendations are followed rest with consumers. This should not be underestimated - it is the

⁶ European Community Regulation laying down the general requirements of food law COM (2000) 716 final: Proposal for a Regulation of the European Parliament and of the Council laying down the general principles and requirements of food law, establishing the European Food Authority, and laying down procedures in matters of food. COM (2001) 475 final: Amended proposal for a regulation of the European Parliament and of the Council laying down the general principles and requirements of food law, establishing the European Food Authority, and laying down procedures in matters of food safety.

⁶ <http://europa.eu.int/comm/food/fs/inspections/vi/reports/index-enhtml>

important last link in the food chain for food safety. The national supervisory authorities, with others, have a duty to try to improve consumers' knowledge about food hygiene in the home, and to provide recommendations, information and education to help consumers manage food risks more effectively.

Poor dietary habits and food choices are a major factor in the causation of food-related disease, especially in industrialised countries. Nevertheless, when consumption of certain safe foods is much higher than needs, consumers can be said to be "digging their graves with their teeth". National authorities should provide the public with information to help them to make their dietary habits consistent with good health.

3. Tackling problems at source – 'Prevention is better than cure'

Different approaches may be used to try to ensure that the levels of contaminants in foods are as low as reasonably achievable and never above the maximum levels considered to be acceptable or tolerable from the health point of view. Essentially, these approaches consist of

- measures to eliminate or control the source of contamination
- processing to reduce contaminant levels and to avoid recontamination
- measures to identify and separate contaminated food from food fit for human consumption - contaminated food should then be rejected for food use.

Previously, most systems for regulating food safety were based on legal definitions of unsafe food, enforcement programmes - to remove such food from the market, and the application of sanctions on those held responsible for contravening the regulations. Such systems have not been successful in dealing with previous or current problems and are unlikely to be able to deal with emerging risks.

In some cases, a combination of the above approaches is used, for example, when emissions from previously uncontrolled sources have resulted in environmental pollution with persistent chemicals that have then entered the food chain. Control of final products can never be extensive enough to guarantee contaminant levels below established maximum levels and safety, and other aspects of food quality cannot be 'inspected into' food at the end of the production chain. In most cases, chemical contaminants cannot be removed from foodstuffs and there is no feasible way in which a batch of contaminated foodstuffs can be made fit for human consumption.

The advantage of eliminating or controlling food contamination at source, i.e. *a preventive approach*, is that this is usually more effective in reducing or eliminating the risk of untoward health effects. Smaller resources for food control are required with this approach and the rejection of foodstuffs and resulting economic and other losses is avoided. It also decreases the spread of the contaminant in the production chain. The BSE case illustrates what happens if these approaches are not effective and contamination spreads: the effects can be devastating and long-lasting for human health, control and enforcement measures, food policy, legislation, trade and economics.

The use of a preventive and integrated approach to the management of food safety through out the food chain is illustrated in the following examples.

3.1 Control of *Salmonella* in poultry

An example of an integrated strategy to control *Salmonella* in poultry, covering the different parts of the feed-food chain, is described in reports from Sweden⁷ and Finland⁸. The overall goal is to ensure that less than 1% of animals sent for slaughter are contaminated with *Salmonella*, thereby ensuring that poultry-

⁷ Zoonoses in Sweden, up to and including 1999. Ed. H. Wahlström. National Veterinary Institute, Uppsala, Sweden, 2001.

⁸ Zoonoses in Finland. 1995-1997 and 1995-1999.

Both available at Internet address http://www.mmm.fi/elintarvikkeet_elaimet/art/haku/jlkhaku_en.idc

meat will be free from *Salmonella*. Consistent application of this strategy has resulted in a prevalence of *Salmonella* in poultry (at slaughter) of less than 1%. The strategies to reach this goal are as follows:

- Prevent *Salmonella* contamination in all parts of the production chain.
- Monitor the whole production chain: surveillance programmes for feed, live animals, carcasses, meat and other foods of animal origin are in place.
- If *Salmonella* is found, action is taken to eliminate the infection/contamination. Any food item contaminated with *Salmonella* is deemed to be unfit for human consumption.

All isolations of *Salmonella* in humans, animals and food of animal origin are notifiable. In addition, findings of *Salmonella* in official samples of food of any origin are notifiable. Primary isolates of *Salmonella* are characterised by sero- and phage-typing the strains and isolates of animal origin are also tested for antibiotic resistance. In order to illustrate how the system works, some details of the measures taken in the poultry area are given below.

Since the frequency of *Salmonella* isolation in Swedish and Finnish poultry flocks is very low, most of the measures in the current control programmes are of a preventive nature. Four factors are of major importance to maintain this favourable situation.

- The breeding pyramid is kept free from *Salmonella* by regular sampling of flocks and hatcheries, as well as by slaughtering a breeder flock where *Salmonella* is detected. No *Salmonella* vaccination is applied. All grandparent animals are imported from Europe and are quarantined and repeatedly tested negative for *Salmonella* before they can be used for production.
- Feed is maintained free from *Salmonella*. The control consists of three parts: import control of feed raw materials, mandatory heat-treatment of compound feedingstuffs for poultry and an HACCP-based *Salmonella* control in the feed industry.
- Strict hygiene and biosecurity standards are in place, preventing the introduction of *Salmonella*.
- Measures are always taken in case of *Salmonella* infection in poultry. If a breeder flock is detected to be *Salmonella* positive at any time of its life, it will be slaughtered. All meat obtained from these flocks, as well as from production flocks is heat-treated. The poultry house is cleaned, disinfected and tested for *Salmonella*. Negative *Salmonella* results must be obtained before the next flock can be re-introduced.

An extensive sampling programme continuously monitors the *Salmonella* situation in poultry. In addition to sampling at the flock level, samples are also collected at all poultry slaughterhouses to monitor the end product.

3.2 Pesticides

In the European Union (EU) pesticides must be subjected to thorough testing and assessment prior to approval for use. Systems are in place in the European Community (EC) and in Codex for the evaluation of pesticides and for setting Maximum Residue Limits (MRLs) in foods and feeds. In order to minimise the risk of high residue levels in food and also to avoid environmental pollution and occupational health risks, pesticides should be used according to the principles of Good Agricultural Practice and, only by persons who have received adequate training. Pesticide residue levels should be monitored in food (including drinking water and sources thereof) and animal feed to ensure that they do not exceed established MRLs. The results of such monitoring should be made public, as they are in Sweden, Finland and many other countries. The fact that information about products containing levels above the MRLs is public helps encourage producers and traders to ensure that their products are in compliance. When residue levels above the MRLs are found in foodstuffs, this triggers increased control of products from the same producer/supplier and remedial action to prevent any repetition.

3.3 Veterinary drugs

In the EU, veterinary drugs, including antimicrobial drugs, are subjected to thorough investigation and assessment prior to approval for use. In many countries the use of antimicrobial drugs is not limited to

therapeutic uses. However, in order to limit the development of antibiotic-resistance, the EC has prohibited the use of four main drugs in feed for growth-promotion purposes. Some countries, such as Finland and Sweden, are even more restrictive and antimicrobials are not used in feed for growth-promotion purposes. In addition, in Sweden and Finland the availability of drugs is limited to veterinary professionals. The levels of residues of veterinary drugs in foods of animal origin are monitored annually and the results made public. When residue levels exceeding the MRLs are found, this leads to a thorough investigation of the source of the problem, which is usually traced to the primary producer. Such strict control measures are essential to manage the risk of development of antimicrobial resistance in food-producing animals and humans with the consequent health implications.

3.4 Mycotoxins and marine biotoxins

The problem of contamination of feed and foodstuffs with mycotoxins, such as aflatoxins, ochratoxin A, patulin and fusarium toxins, is best tackled by a systematic examination of the whole production, processing and distribution chain in order to discover the points at which contamination is likely to occur. In this way appropriate preventive and control measures can be taken. Mycotoxin levels in primary products can vary widely from year to year, depending on, among other things, climatic conditions during harvesting. Thus there is a need for constant vigilance and co-operation between agricultural advisory and control services, the food control authorities and food and feed producers. The Codex Committee on Food Additives and Contaminants (CCFAC) has developed and is developing codes of practice to reduce contamination of food and animal feed with mycotoxins⁹. Such codes of practice can form the basis of advice at the national level on preventive measures. Through the control of aflatoxins in animal feed components and routine monitoring of aflatoxin M1 in milk back to the individual farmer it is possible to ensure that aflatoxin levels in milk are kept below the current strict EC maximum limits. Although a considerable amount of work has been done, there is a need for much more research on mycotoxins in order to provide a sound scientific basis for recommendations for both pre- and post-harvest measures: such research is being supported by the EC.

It is very difficult to tackle the problem of contamination of shellfish with certain marine biotoxins, such as DSP and PSP, at source. Control efforts are therefore mainly directed towards trying to predict and detect relevant algal blooming, and to pre-harvest examination of shellfish for toxins in order to prevent contaminated products reaching the consumer.

3.4 Persistent environmental pollutants

Earlier emissions of persistent chemicals, such as PCBs, dioxins and mercury have led to contamination of foodstuffs, especially foods of animal origin (particularly fish). There is an on-going need for monitoring and control of some products to ensure that they do not contain levels above safe limits. In order to protect public health it may also be advisable to issue recommendations to susceptible population groups, for example, women of childbearing age, advising them to restrict their consumption of certain fish species, or fish from contaminated waters.

The most effective way to reduce the levels of environmental contaminants in food (and thus human exposure) is to take measures to reduce emissions from industry and other sources. (The levels of methylmercury in fish from some oceans is unfortunately due to volcanic activity and therefore not amenable to control.) In recent decades the introduction of such measures has resulted in a number of success stories. For example, the levels of lead in human blood have dropped quite dramatically in countries where lead is no longer added to petrol. Likewise, measures to control pollution with dioxins and PCBs, and a ban on the use of persistent pesticides, such as DDT, has led to a marked reduction in the levels of these substances in food and in human exposure, as measured by the levels in human milk. This is an example of an area where co-operation between the authorities responsible for food safety and environmental protection has borne fruit. Although the levels of PCBs have decreased, it is important that

⁹ Codex Committee Food Additives and Contaminants, Codes of practice to reduce contamination of food and animal feed with mycotoxins, Codex Alimentarius, Rome 2001

control on the disposal of PCB-containing materials is continued, otherwise there is a risk that environmental pollution and levels in food will start to increase again.

4. Emerging risks – 'Looking for trouble'

Agencies responsible for food safety should have a 'reconnaissance' or 'intelligence' function with the task of detecting emerging risks, which may arise at any point in the food chain. These risks could be due to emerging pathogens, for example pathogens resistant to a wide range of antibiotics, to the use of new feed components, new industrial or domestic chemicals, new production, processing and handling methods or to changes in dietary habits. The detection of emerging risks is one of the specific tasks assigned to the proposed European Food Authority.

5. Recommendations and topics for discussion

- 5.1 Food safety strategies should be risk-based, giving priority to measures that have the potential to result in the greatest reductions in food-related diseases.
- 5.2 An integrated, multidisciplinary approach to food safety should be adopted throughout the food chain (food production, processing, and distribution, including animal feed and other aspects of primary production).
- 5.3 A preventive approach to food safety should be adopted in order to decrease the risk of food contamination, tackling problems at source wherever possible.
- 5.4.1 The results of all official monitoring tests (pesticide residues, veterinary drugs residues and other contaminants in food, feed and drinking water), official food inspections and other official food control activities should be made public.
- 5.5 Education and training about food hygiene, throughout the food chain (including catering personnel and consumers) should be improved.