

FOOD SAFETY AND ENVIRONMENTAL SANITATION

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Summary

It is generally accepted that the assurance of food safety is primarily connected with the elimination of contamination in the full cycle of food production, starting from the growing of cereals and vegetables through manufacturing, storage, and distribution, until the final preparation of food in the kitchen. Although the wide use of chemicals in agriculture has provided numerous benefits, the residues of chemicals represent an additional health hazard for the consumer. Within good agricultural practice in the use of chemicals, integrated pest management may play an important role in the reduction of such hazards. Providing enough food for the increasing world population while protecting the environment requires equitable and sustainable agricultural development. A significant source of environmental pollution is the emission of toxic components by industry and automobiles. Efforts to reduce the emission of industry and motor vehicles may result in a significant improvement in environmental sanitation.

1. Introduction

It is generally accepted that the assurance of food safety is primarily connected with the elimination of contamination in the full cycle of food production, from raw materials through manufacturing to finished products and kitchen operations. Among potential contaminants, primarily pesticides, heavy metals, and some biological contaminants have to be taken in consideration. The majority of these contaminants are of environmental origin. So it is understandable that a prerequisite of the production of

safe food is the hindering of pollution in the environment. In this chapter some aspects of interrelations of food safety and environmental sanitation will be treated.

2. Integrated Pest Management and Food Safety

The last 40 years of the twentieth century saw a remarkable scientific revolution in agriculture, in which chemical technology played a major role. A broad range of chemicals is now used in agriculture to reduce the losses caused by different pests. Pests—including insects, mites, pathogens (disease-causing microorganisms), weeds, nematodes, rodents, and others—contribute to high farm-producing costs and reduced quality and yields. Farm production losses to pests are estimated to exceed 35% annually. So it is understandable that reduction of these losses by using different chemicals is important from the point of view of increasing the effectiveness of agricultural production.

The use of chemicals in agricultural production has provided numerous benefits in terms of increasing production and quality. However, as a result, consumers are exposed indirectly to chemicals, usually in minute quantities. Although the level of residues in food is low, they represent an additional health hazard for people consuming residue-containing food. Because some types of these chemicals, such as organo-chlorine pesticides, heavy metals, and triazine herbicides, could not be degraded by naturally occurring soil microorganisms, the soil and water could also be polluted. In addition, it should be mentioned that because of transformation of pesticides in plants and soil, different metabolites are formed. Some of them may also be toxic.

In 1990 the US Environmental Protection Agency (EPA) released results of a national survey of pesticides in community water systems and rural domestic wells.

About 10% of the community water systems and 4% of the rural domestic wells contained detectable concentrations of pesticide, while more than 50% of the wells surveyed contained detectable concentrations of nitrate.

For pesticides, less than 1% of all the wells surveyed had concentrations slightly above levels considered safe for human health, while about 1% of the community wells and about 2.4% of the private rural wells contained nitrate concentrations above the maximum contaminant level established to protect human health.

As of the late 1990s, there is no evidence that pesticides, when used according to good agricultural practices, have caused any harm to human health. In all recorded cases where food has been implicated in a pesticide poisoning, the contamination was due to inappropriate or illegal use. In a number of cases, food has been contaminated because of unsafe packing and leakage of pesticide during storage or transport. In other cases, seeds were consumed that had been treated with fungicides and were intended for planting. FDA studies, based on regulatory monitoring, incidence/level monitoring, and the Total Diet Study concerning pesticide residues in food conducted during 1985–1991, indicated few problems with contamination. Fewer than 50 of 10 000 regulatory samples—and none of the more than 14 000 samples tested under the program—had residues above safe levels. Nearly all the residues at higher levels were pesticides for

which no tolerance limits had been set for that particular food. Similar results were obtained in a similar study conducted in Switzerland.

In developing countries, poor infrastructure has not permitted an accurate assessment of the problem of chemicals in food. Indirect information suggests that consumers may be routinely exposed to a high level of pesticides in their diets. For example, the large number of acute poisonings in agricultural workers implies a poor knowledge of the handling and application of pesticides. Indeed, monitoring data on food imported from developing countries indicates that these foods are sometimes highly contaminated at their point of origin.

Although hundreds of different chemicals are used in agriculture, most people are concerned about pesticides, specifically their impact on the environment and public health.

This long-running concern helped stimulate the formation of the Environmental Protection Agency (EPA) and stricter laws on pesticides registration and use in the early 1970s.

One healthy outcome of this public concern has been a new emphasis on responsible agricultural management of pesticides; for example, more pesticide applicator training programs, and the increased use of integrated pest management techniques (IPM).

In the 1990s, several food contamination incidents—such as ethylene dibromide in grain products, and heptachlor in milk and poultry—have drawn considerable media coverage and centered public concern on the health risks of pesticides.

2.1. What are the Health Hazards of Pesticides?

Any harmful health effects of pesticides are usually associated with the amount or dose of the pesticide. For example, a chemical worker who during manufacture of a pesticide harmful to humans accidentally comes into direct contact with large amounts of the pesticide could face serious injury. Yet, because the danger is so great, strict safety requirements have drastically reduced the likelihood of such an industrial accident occurring.

Another type of hazard is faced by those who repeatedly misuse pesticides in an agricultural setting, or are themselves the victims of misuse. For example, a farmer who continually ignores pesticide label warnings or a farm worker who is repeatedly sent into a field too soon after spraying, may face long-term health risks. The public health community is still learning more about the health risks to agricultural workers from repeated exposure to pesticides through misuse. However, experts believe this is a far bigger risk than dietary exposure, simply because the exposure to pesticides in agricultural settings is greater.

Results of many studies conducted in several countries confirm the view that when the use of pesticides follows the rules of Good Agricultural Practice, the health hazard is low. On the other hand, people involved for the long term with the handling of

pesticides and herbicides may be exposed to harmful doses of these chemicals. A radiometric assay used to measure acetyl-cholinesterase activities in plasma and red blood cells of 14 fumigators, 26 herbicide applicators, 20 herbicide and insecticide applicators, and persons employed in agriculture who did not routinely apply pesticides, showed a significant decrease in enzyme activity in pesticide applicators who use organophosphates, phosphine, and 2-methoxy-3, 6-dichlorobenzoic acid. These facts stress the importance of strict safety measures in the use of pesticides.

2.2. Goals of Integrated Pest Management

Integrated Pest Management (IPM) is an ecological approach to pest suppression. Briefly stated, the goals of IPM systems are to reduce losses in crop and animal quality and yield caused by pests, and to increase net profits to the producer. Methods are selected that cause minimal environmental damage and pose little or no risk to human health. IPM involves selection, integration, and implementation of pest control actions on the basis of predictable economic, ecological, and sociological consequences. Success is most likely when the focus is on a large area.

Development and use of many efficient and economical pesticides have permitted unprecedented crop and animal protection and improved public health. Because these control agents have been available, however, many of the components of IPM systems—such as crop rotation, sanitation, time of planting, resistant varieties, and genetic and biological control methods—have been neglected.

However, the bright future of the pesticides era became clouded as the problems of secondary pests (in addition to target pests), destruction of natural enemies, pesticide resistance, and environmental and health hazards were recognized. Experience has shown that adoption of a single control measure for suppression of a target pest or pest complex is destined to fail sooner or later. For sustaining long-term crop protection, multiple pest suppression techniques are needed.

Establishment of an integrated pest suppression system should be based on thorough knowledge of:

- Crop and animal production methods
- Biology and ecology of each pest species and basic information on the genetics and physiology of pest species
- Relationships of the pests with the crop and other biological and physiological components of the ecosystem
- Potential economic damage of each pest and pest complex

This information is necessary if community-involved, area-wide programs are to effectively identify and integrate control technologies compatible with crop production methods, as well as with other parts of the ecosystem.

Knowledge of farmland production potential, agronomic inputs, and plant growth and development is essential in the development of IPM systems. Cultivar selection and planting dates, and cultural practices (irrigation, fertilization, and tillage) may have a major influence on pest severity. Decisions on the need for control action are based, not

only on pest population levels, but also on the present and predicted weather, the levels of existing biological control agents, and on the stage of plant development and on the potential for yield losses. Similar information is vital in development of animal protection IPM systems.

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Biographical Sketch

Anna Halász, D.Sc., is visiting consulting professor of the Department of Food Science of the Central Research Institute of Food Industry, and associate professor of Budapest University of Technology and Economics.

She received her M.Sc. Degree from Budapest University of Technology and Economics (faculty of Chemical Engineering) in 1961, and her D.Sc. degree in 1968 from the Hungarian Academy of Sciences. Dr. Halász is Chairman of the section of Food and Agriculture of the Hungarian Biochemical Society, a member of the Working group on Microbiology of the Hungarian Scientific Society for Food Industry, and a member of the Yeast Working Group of the International Association for Cereal Science and Technology.

She has been the recipient of the Distinguished Researchers Award of the Ministry of Agriculture, and she was awarded the Bronze Medal of the Hungarian Republic. She is also a recipient of the Swiss Federal Foundation Fellowship in science (1970, 1971).

Dr. Halász has presented more than 100 invited lectures at international and national scientific meetings, universities, and other institutions. She has published more than 100 research papers. Her major interest is food microbiology and food safety.