GEMS: GLOBAL ENVIRONMENTAL MONITORING SYSTEM
Joint FAO/WHO Food and Animal Feed
Contamination Monitoring Programme

SUMMARY AND ASSESSMENT OF DATA RECEIVED FROM THE FAO/WHO COLLABORATING CENTRES FOR FOOD CONTAMINATION MONITORING

Prepared under the joint sponsorship of the

United Nations Environment Programme, the

Food and Agriculture Organization of the United Nations, and the

World Health Organization

NATIONAL FOOD ADMINISTRATION, UPPSALA, 1982

A limited number of copies of this publication are available for distribution from:

The United Nations Environment Programme, Nairobi, Kenya

The Food and Agriculture Organization of the United Nations, Rome, Italy

The World Health Organization, Geneva, Switzerland

and The National Food Administration, Uppsala, Sweden

ACKNOWLEDGEMENTS

The United Nations Environment Programme, the Food and Agriculture Organization of the United Nations, and the World Health Organization acknowledge the valuable participation in this programme of the Collaborating Centres for Food Contamination Monitoring. Without the submission of data from these Centres, this report would not have been possible.

The valuable work of Dr Stuart A. Slorach, the National Food Administration, Uppsala, Sweden, who evaluated the data on levels of contaminants in food, of Dr Charles F. Jelinek, US Food and Drug Administration, Washington, D.C., who evaluated the data on dietary intakes of contaminants, and of Dr Alan R. Stiles, who established the data collection and processing system, is gratefully acknowledged.

Contents

SUMMARY AND ASSESSMENT OF DATA RECEIVED FROM THE FAO/WHO COLLABORATING CENTRES FOR FOOD CONTAMINATION MONITORING.

Summary and Assessment of Data Received from the FAO/WHO Collaborating Centres for Food Contamination Monitoring

SUMMARY

This report contains a summary and assessment of the data received from the FAO/WHO Collaborating Centres for Food Contamination Monitoring in 19 countries during the period 1977 to 1980. The data refer to the levels of certain organochlorine compounds, lead, cadmium, and aflatoxins in samples of individual foods and in food composites representing the whole of the diet, collected during the period 1971-1979. Most of the data have been submitted by developed countries.

The levels of the DDT complex in cereals, fruits, vegetables, and vegetable fats and oils reported by developed countries are generally low, in most cases below the limit of detection. In many countries, there is a marked decline in the levels of the DDT complex in foods of animal origin (e.g., milk fat, butter, eggs, and fish) and in human milk, during the period studied.

Data from Japan show that the levels of total hexachlorocyclohexane (HCH) isomers in foods of animal origin and in human milk have declined markedly since 1971, when the extensive use of HCH there ceased. Total HCH levels in foods in Canada and the USA have been low throughout the period studied.

The reported levels of heptachlor and its epoxide and of aldrin and dieldrin are generally very low, often below the limit of detection. A downward trend in the levels of aldrin and dieldrin in the fat of cow's milk has been seen in several countries. The data on hexachlorobenzene (HCB) do not show any general trends in levels in foods. Japanese data show a decline in the levels of polychlorinated biphenyls (PCBs) in the fat of cow's milk, in fish, and in human milk, during the period studied.

Very few of the reported levels of organochlorine compounds exceed the residue limits or guideline levels recommended under the Joint FAO/WHO Food Standards Programme.

Comparison of the data on lead levels in fresh and canned fruit and vegetables reveals that the canned products almost always contain much higher levels than the corresponding fresh product, in many cases more than 5 times as much. The major source of lead in canned foods is the solder used in can production. The food control authorities in many countries have been aware of this problem for many years. The downward trend in the levels of lead in canned foods seen in some data is the result of improvements in can-making and canning practice made by the industry in response to this concern.

Data submitted on cadmium do not show any clear time trends in the levels of cadmium in cereals or cereal flours, in kidney, or in crustacea and molluscs.

Eight countries submitted data from total diet studies on the dietary intake of contaminants. In almost all cases, the estimated dietary intakes of the organochlorine pesticides are well below the acceptable daily intake (ADI). Data from Canada, Guatemala, Japan, the United Kingdom and the USA indicate that the dietary intakes of cadmium are more apt to be close to, and in one case slightly exceed the provisional tolerable weekly intake established by the Joint FAO/WHO Expert Committee on Food Additives (JECFA). These results indicate that the uses of cadmium should be monitored closely. The estimated median dietary intakes of lead reported by various countries do not exceed the provisional tolerable weekly intake established by JECFA. Only one country (Guatemala) submitted data on aflatoxins and these mycotoxins were not detected in any of the samples analysed.

The levels of DDT and aldrin and dieldrin in human milk are such that the daily intake by the breast-fed infant may, in some cases, exceed the ADI, established by the Joint Meeting on Pesticide Residues (JMPR). However, the ADI is developed on the basis of lifetime exposure, and short-term variations may not have the same significance. Furthermore, considering that the alternatives for feeding the infants may subject them to even greater health risks and, because of the well recognized nutritional and immunological advantages of breast feeding this practice should not be discouraged. Monitoring should be continued and efforts to prevent the contamination of breastmilk with these compounds should have great priority.

So far, data on contaminants in animal feed have not been collected in this Programme. The future of this part of the project will be decided when a survey of national animal feed monitoring activities has been completed.

Analytical quality assurance (AQA) studies were conducted during 1980. The results indicate that large differences exist between laboratories with regard to analytical capability. Interlaboratory quality assurance studies are seen as an integral and necessary part of this monitoring programme.

1. Introduction

1.1 OBJECTIVES

The Joint FAO/WHO Food and Animal Feed Contamination Monitoring Programme has been developed in response to a recommendation of the United Nations Conference on the Human Environment held in Stockholm in 1972, resolutions from the World Health Assembly concerning problems of the human environment, and recommendations of the FAO Conference concerning the assessment and ecological management of resources for food and agriculture. The Programme is supported by the United Nations Environment Programme (UNEP) and comes within the framework of the Global Environmental Monitoring System (GEMS).

The major objectives of the Programme can be summarized as follows:

(a) to cooperate with governments wishing to initiate or strengthen food and animal feed contamination monitoring programmes, in order to strengthen the national services responsible for the control and prevention of food and animal feed contamination;

(b) to collect selected data, generated in national monitoring programmes, on the levels of a limited number of chemical contaminants in individual foods and animal feeds, to collate and evaluate these data, and to produce and disseminate summaries and reviews of trends and patterns of food and animal feed contamination;

(c) to obtain estimates of the dietary intake of certain chemical contaminants, with a view to correlating these data with those on the intake of the same contaminants from other sources (e.g., air). Where appropriate, to relate the total exposure to a contaminant to data on the levels of the contaminant in human tissues or body fluids (it is planned to collect such data in another project in the current WHO Health-Related Monitoring Programme of GEMS);

(d) to provide the Joint FAO/WHO Codex Alimentarius Commission with information on the levels of contaminants in food to support and accelerate its work on international standards for contaminants in foods.

1.2 PROJECT IMPLEMENTATION

The development of the food contamination monitoring programme has so far gone through two phases. Main activities carried out or planned during all three phases of the programme, together with the temporal order of the various stages of data collection, are shown in Appendix I.

1.2.1 Phase I (1973-1976)

During Phase I of the Programme, consultants visited 13 countries and prepared reports on their food contamination monitoring activities. An expert consultation[a] was held in 1974, to advise on priorities with regard to contaminants and foods to be monitored, and methods of sampling and analysis. A second consultation[b] was held in 1975, to advise on the development of a system for the processing, appraisal, and storage of the data to be collected in the Programme.

1.2.2 Phase II (1977-1981)

Since 1977, FAO/WHO have invited 21 countries with existing food monitoring activities to participate in Phase II of the Programme by supplying selected data on certain contaminants. The data have been submitted to WHO in Geneva by the designated Collaborating Centre in each participating country.

The contaminants and foods for which data were to be collected and the roles of the Collaborating Centres were discussed with the participating governments at a Consultation[c] in Geneva in 1977.

A Technical Advisory Committee, composed of experts representing the Collaborating Centres, met in 1978[d], and again in 1981[e], to review issues and to provide guidance on the scientific and operational aspects of the Programme.

1.2.3 Guidelines

One of the objectives of the Programme is to cooperate with governments wishing to establish or strengthen national food contamination monitoring programmes. To this end, guidelines[f] on this subject have been prepared (in English, French, and Spanish) and distributed. A provisional edition of "Chemical Contaminants in Food - Approaches for Estimation of Intake" has been prepared by FAO.

---

a) FAO/WHO Expert Consultation to Identify the Food Contaminants to be Monitored and to Recommend Sampling Plans and Methodology. Rome, 1974. (FAO-ESN: MON/74-14; WHO-FAD/FCM/74.14.)

b) Expert Consultation on the Joint FAO/WHO Food Contamination Monitoring Programme - Development of System for Processing, Appraisal and Storage of Data. Geneva, 1975. (WHO-FAD/FCM/75.1; FAO-ESN MON/75.1.)

c) Report of the Consultation on the Joint FAO/WHO Food and Animal Feed Contamination Monitoring Programme - Phase II. Geneva, 1977. (WHO-FCM/77.9; FAO-ESN: MON/77.9.)

d) Report of the First Session of the Technical Advisory Committee Meeting on the Joint FAO/WHO Food and Animal Feed Contamination Monitoring Programme Phase II. Rome, 1978. (FAO-ESN/MON/TAC-1/78.1; WHO-FAO/FCM/TAC-1/78.1.)

e) Report of the Second Session of the Technical Advisory Committee. Geneva, 1981. (FAO-ESN/MON/TAC-2/81/5; WHO-EFP/81.15.)

f) Guidelines for establishing or strengthening national food contamination monitoring programmes. Geneva, 1979. (WHO/HCS/FCM/78.1; FAO Food Control Series No. 5.)

1.2.4 Analytical Quality Assurance

During 1980, an analytical quality assurance (AQA) exercise was carried out within the Programme in order to gain some idea of the validity of the data currently being generated. The results of this AQA exercise have been published[a], and a summary of the main conclusions is given in paragraph 2.6.

1.2.5 Biological Contaminants

The possibility of including not only chemical contaminants but also biological contaminants has been discussed at several of the consultations held during the development of the Programme. However, it has been decided, at least for the time being, not to collect any data on biological contaminants. This does not in any way imply that biological contaminants in food or animal feed are of minor importance, from the point of view of health or economics.

1.2.6 Animal Feed Contamination Monitoring

As implied by its title, it was originally intended to include animal feed contamination monitoring in the Programme. Consultant visits have been made to a number of countries and it has proved difficult to identify national programmes, in progress, on animal feed contamination monitoring. The Collaborating Centres have therefore not yet been asked to submit data on contaminants in animal feed.

1.2.7 Data Collection, Processing, and Storage

The Collaborating Centres in the participating countries have submitted selected data on the levels of certain chemical contaminants in individual foods and in food composites representing the whole of the diet ("total diet" samples) to WHO Geneva, where these data have been checked, coded for electronic data processing, and stored in a computer. The data collected during Stages I-IV (1977-1980) have now been issued in a document[b] in which the information is grouped according to country (Part A) and contaminant (Part B). This data base should be consulted for further details of the data being discussed in the present report.

---

a) Analytical Quality Assurance of Monitoring Data. Geneva, 1981. (FAO-ESN/MON/AQA/81/8, WHO-EFP/81.17.)

b) Summary of Data Received from Collaborating Centres - 1977 to 1980:
Part A - Countries (FAO-ESN/MON/DCC/81/9-A and WHO-EFP/81.19A).
Part B - Contaminants (FAO-ESN/MON/DCC/81/9-B and WHO EFP/81.19B).

1.3 COMPARISON OF MONITORING DATA WITH MAXIMUM RESIDUE LEVELS, ACCEPTABLE DAILY INTAKES OR TOLERABLE WEEKLY INTAKES

In this report, monitoring data on levels of contaminants in foods are compared with residue limits (RLs) recommended by the Joint FAO/WHO Meeting on Pesticide Residues (JMPR). Wherever possible, results from total diet studies are compared with acceptable daily intake figures (ADIs) recommended by the JMPR or provisional tolerable weekly intake (PTWI) figures established by the Joint FAO/WHO Expert Committee on Food Additives (JECFA).

The acceptable daily intake for man (ADI), expressed on a body-weight basis, is the amount of a pesticide (or food additive) that can be taken daily in the diet over a lifetime without appreciable risk to the health of the consumer. The JMPR has established ADIs for the most commonly used pesticides.

Residue limits are established by the JMPR for the most commonly internationally used pesticides; a residue limit is defined as the maximum concentration of a pesticide residue that is allowed in or on a food commodity at a specific stage in the harvesting, storage, transport, marketing, or processing of a food, up to the final point of consumption. These limits are based on the following information: use patterns, residues resulting from supervised trials, fate of residues, and national tolerances. RLs are intended to allow the proper use of pesticides in agriculture, without endangering the health of the consumer.

The RLs recommended by the JMPR are then considered by the Codex Committee on Pesticide Residues (CCPR), one of the subsidiary bodies of the Codex Alimentarius Commission. Its main function is to propose, on the basis of the recommendations of the JMPR, international RLs for pesticide residues in specific foods to the Commission.

The JECFA has established ADIs for the most commonly used food additives. Since 1972 the JECFA has also evaluated several food contaminants, such as lead, cadmium and mercury. As an endpoint for its toxicological assessment of these cumulative metals the JECFA has established provisional tolerable weekly intakes for man (PTWIs) for these metals, expressed on a per person or body-weight basis. JECFA acts as an advisory body to the Codex Committee on Food Additives (CCFA). Through the Codex Alimentarius Commission, the CCFA proposes levels for contaminants (and additives) in various foods to governments for international acceptance.

For the protection of the health of the individual, the amount of a pesticide or contaminant consumed by an individual should not, except under special conditions, exceed the ADI or PTWI over a prolonged period of time. To ascertain whether a consumer is at risk or not, the ideal way is to compare the actual intake with the ADI or PTWI. Such measurements are very laborious and time-consuming. Therefore to assess this risk in practice, estimates are based upon information concerning the levels of residues that could possibly occur in individual foodstuffs and upon appropriate figures for the amounts of each kind of food likely to be consumed (total diet studies). Two problems are, therefore, involved in arriving at such estimates. One concerns the selection of appropriate food consumption data; the other concerns the choice of residue levels.

2. Assessment of Data Included in the Present Report

2.1 GENERAL COMMENTS

In 1979, a Summary Report[a] of the data submitted to WHO by the Collaborating Centres during Stage I of Phase II (i.e., 1977) was produced. The aim of the present report is to summarize and comment on the data received from the Collaborating Centres during Stages I-IV of Phase II. Thus, it covers the data included in the first Summary Report, as well as those submitted up to 1980, covering samples up to 1979. Data received for 1980 samples are not discussed in this report.

Because of the volume of data received, it is not possible, or meaningful, to discuss all these data in detail in this report. Attention has therefore been concentrated on data representative of the whole country and which either show trends in contamination or are most relevant to the objectives of the Programme. Certain data, which were not specifically requested, are included in the computer printout and a few of them will be discussed here.

2.2 COLLABORATING CENTRES SUBMITTING DATA

FAO/WHO Collaborating Centres have now been designated in 23 countries (Appendix II). With the exception of Australia, China, and the USSR, in which Centres were recently designated, all the Centres have submitted data to WHO during Stages I-IV. However, not all countries have submitted data at each stage or on all contaminants. It should be noted that the majority of the Collaborating Centres are located in developed countries.

2.3 DATA REQUESTED IN PHASE II, STAGES I-IV

Phase II of the Programme has been divided into four Stages for the collection of data: Stage I - 1977, Stage II - 1978, Stage III - 1979 and Stage IV - 1980 (Appendix I). Details on the data requested at each of these stages are shown in Appendix III.

With regard to the organochlorine contaminants in human milk, the Collaborating Centres were invited to submit data on all the organochlorine compounds that had been found in this food, in their respective countries.

The data on organochlorine compounds in milk and milk products were requested on a fat basis, but the data on these contaminants in human milk and other foods were requested on a fresh weight ("as is") basis.

---

a) Summary Report of Data received from Collaborating Centres for Food Contamination Monitoring - Stage I - 1977, under the Joint FAO/WHO Food and Animal Feed Contamination Monitoring Programme. Phase II. Geneva, 1979. (FAO: ESN/MON/78.2; WHO HCS/FCM/78.2.)

2.4 METHODS OF REPORTING LEVELS OF CONTAMINANTS IN FOODS

In Stage I, the 1977 Consultation[a] suggested that for the levels of organochlorine compounds in foods, the following data should be collected: arithmetic mean, overall range, 10th percentile, 50th percentile (median) and 90th percentile.

For lead it was suggested that the results should be reported in percentages within up to 10 equidistant ranges, covering all the values found, as well as the arithmetic mean and the overall range. However, it was decided at the First Session of the Technical Advisory Committee[b] that, for all data on contaminants to be collected in Stage II, only the median and 90th percentile would be requested. The use of these statistical parameters was considered to be more pertinent to the objectives of the Programme.

The data collected during Stages I-IV are now stored in the computer at WHO in Geneva.

As far as the levels of organochlorine compounds, cadmium, and aflatoxins are concerned, only the median and 90th percentile figures have been computerized.

As far as the levels of lead are concerned, for the data collected in Stage I (1977), the arithmetic means and the maximum levels have been stored in the computer. For the lead data collected in Stages II to IV (1978 to 1980) the medians and 90th percentiles have been computerized. In the data base[c], all the data on lead levels come under the headings "median" or "90th percentile". However, the lead data collected during Stage I (i.e., arithmetic means and maxima) are preceded by an asterisk (*). Moreover, Stage I data have already been reported and reviewed in detail in the first Summary Report[d], to which the reader should refer, if further clarification is required on this point.

---

a) Report of the Consultation on the Joint FAO/WHO Food and Animal Feed Contamination Monitoring Programme - Phase II. Geneva, 1977. (WHO-FCM/77.9; FAO-ESN: MON/77.9.)

b) Report of the First Session of the Technical Advisory Committee Meeting on the Joint FAO/WHO Food and Animal Feed Contamination Monitoring Programme Phase II. Rome, 1978. (FAO-ESN/MON/TAC-1/78.1; WHO-FAO/FCM/TAC-1/78.1.)

c) Summary of Data Received from Collaborating Centres - 1977 to 1980:
Part A - Countries (FAO-ESN/MON/DCC/81/9-A and WHO EFP/81.19A).
Part B - Contaminants (FAO-ESN/MON/DCC/81/9-B and WHO EFP 81.19B).

d) Summary Report of Data Received from Collaborating Centres for Food Contamination Monitoring - Stage I - 1977, under the Joint FAO/WHO Food and Animal Feed Contamination Monitoring Programme. Phase II. Geneva, 1979. (FAO: ESN/MON/78.2; WHO: HCS/FCM/78.2.)

2.5 VALIDITY AND COMPARABILITY OF DATA

This Summary Report concerns retrospective data, much of which was generated more than 5 years ago. In many cases, the data submitted by the Collaborating Centres were pooled results from several laboratories. The Collaborating Centres submitting the data were asked to state, in general terms, how the reliability of the analytical results was confirmed.

In several, but not all, countries, the Collaborating Centres reported that national studies to validate the performance of an analytical method (collaborative study) were carried routinely for analytical quality assurance and/or that check samples (e.g., US National Bureau of Standards standard reference materials) were analysed to check the validity of the analytical results. In a few cases, the quality of the data was checked by participation in international collaborative studies. Not all laboratories contributing data to the Programme carry out analytical quality control routinely, but data were not rejected for this reason.

The reported limits of detection for the same contaminant in the same food often vary from country to country. Thus, the fact that the levels in one country are below the limit of detection of the analytical method used there does not necessarily mean that they are lower than in other countries, in which the contaminant has been detected.

Collaborating Centres were asked to state whether the samples analysed were considered to be representative of the entire country or only of a certain part of it. In many cases, the latter was true. However, criteria were not established for judging whether a sample were representative or not, and there may well be differences between countries in this respect.

It is difficult to draw conclusions on the global contamination situation from the present data, since they have been submitted from relatively few countries; little information is available from developing countries.

These factors, together with the fact that, in some cases, the number of samples analysed is small, mean that considerable caution must be exercised in drawing conclusions concerning differences or changes in levels of contaminants in foods from the data in this Report. This is especially true for comparisons between different countries.

2.6 ANALYTICAL QUALITY ASSURANCE STUDIES

Analytical quality assurance (AQA) studies were carried out during 1980 for the three groups of contaminants - organochlorine pesticides and PCBs, lead and cadmium, and aflatoxins. The studies were planned by a Consultation[a] with the responsible officers of the three institutions that organized the studies. Results of these studies have been published separately[b].

---

a) Analytical Quality Assurance, Report of a Consultation held in Geneva, 1980. (HCS/FCM/80.1.)

b) Analytical Quality Assurance of Monitoring Data. Geneva, 1981. (FAO-ESN/MON/AQA/81/8, WHO-EFP/81.17.)

The AQA study for organochlorine compounds was organized by the National Food Administration, Uppsala, Sweden. Mixtures of PCBs and organochlorine pesticides (HCB, alpha-, beta- and gamma-HCH, *p,p'*-DDT and *p,p'*-DDE, dieldrin and heptachlor epoxide) in iso-octane, soya bean oil, or butter fat (butter oil) were sent to the 34 laboratories in 13 countries participating in the exercise. From the results, it was concluded that "The present exercise revealed large differences between laboratories as regards analytical capability. Several laboratories were unable to correctly identify certain organochlorine compounds even when present in a pure organic solvent.... Other laboratories were able not only to identify all the substances correctly but also to quantitate the levels in the samples accurately. One of the reasons for errors in quantitation was the use of standard solutions which were too old or which for other reasons did not contain the expected concentration of the organochlorine compound concerned.... It is encouraging to find that most of the laboratories in participating countries which have submitted a large amount of data on organochlorine compounds performed well in the present AQA exercise. In most cases the mean deviation of their results from the spiked levels was within the range $\pm$ 20 %, in many cases within the range $\pm$ 10 %."

The AQA study on aflatoxins was organized by the International Agency for Research on Cancer (IARC), Lyons, France. Samples of raw peanut meal, deoiled peanut meal, and yellow cornmeal with aflatoxins B_1, B_2, G_1, and G_2 and a sample of lyophilised cow's milk with aflatoxin M_1, were sent to the 30 laboratories in 11 countries that participated in the test. The results of the analyses of these samples were included with results from the laboratories already participating in the Aflatoxin Check Sample Survey Programme being carried out by IARC with support from the US Food and Drug Administration. Relatively large inter-laboratory variations were noted for results from all four samples; these increased significantly as the levels of aflatoxins decreased. In one sample, however, for which the levels of contamination were known, the mean values determined were not significantly different from the actual spiked levels. In general, the results of the laboratories participating in the FAO/WHO food contamination monitoring programme paralleled those of the overall group participating in the IARC check sample programme.

The AQA study on lead and cadmium was organized by the Ministry of Agriculture, Fisheries and Food, Norwich, United Kingdom. Samples of freeze-dried vegetables and shellfish containing lead and cadmium as contaminants were sent out and results were received from 37 laboratories in 14 countries, which participated in this test. It was concluded that "....20 percent of the results were eliminated as outliers. The mean and mode obtained for samples in most instances differed substantially from certified or expected values, intra-laboratory variances were comparable with that of the Association of Official Analytic Chemists (AOAC) standard methods, inter-laboratory error, however, was excessive. Statistical examination of data did not demonstrate that the variety of analytical methods was the cause of high inter-laboratory error".

The Second Session of the Technical Advisory Committee emphasized that AQA must be an integral part of analytical work and not an exercise carried out only occasionally. In order to ensure the validity of the data being collected in the monitoring programme, it is important that WHO/FAO encourage the national authorities concerned to include AQA within their monitoring programme. The Committee noted that the results of the current AQA studies allow few conclusions to be drawn concerning the reliability of previously collected data. However, an important contribution of a continuing AQA programme should be to improve the overall reliability of data collected by means of positive feedback to those laboratories performing poorly in the AQA exercises.

3. Summary and Assessment of Data Submitted on Levels of Contaminants in Individual Foods

3.1 ORGANOCHLORINE COMPOUNDS

3.1.1 Analytical methods

Most laboratories determined organochlorine compounds by similar methods based on gas-liquid chromatography. In most countries some kind of intra- or interlaboratory analytical quality assurance (AQA) study was carried out. However, AQA varied widely between laboratories.

3.1.2 DDT Complex (*p,p'*-DDT, *o,p'*-DDT, *p,p'*-DDE and *p,p'*TDE)

The insecticide DDT was introduced in the 1940s and was used on a very large scale, during the following two decades, in public health programmes to control vector-borne diseases, such as malaria, and in agriculture and forestry. During the 1970s, many countries introduced restrictions or a ban on the use of DDT. However, DDT is still used extensively in both agriculture and vector control in some countries.

The toxicity of DDT and its derivatives has been reviewed by several WHO expert bodies (1). A conditional ADI of 0.005 mg/kg body-weight has been established for the DDT complex (sum of *p,p'*-DDT, *o,p'*-DDT, *p,p'*-DDE and *p,p'*-TDE (DDD)) by the Joint Meeting on Pesticide Residues (JMPR).

Under the Joint FAO/WHO Food Standards Programme, temporary residue limits have been established for DDT complex and these are given in Appendix IV.

3.1.2.1 Summary of monitoring data

Cereals and cereal flours

Data from the Federal Republic of Germany, Japan, Kenya, Switzerland, the United Kingdom and the USA show, in general, median levels of DDT complex of 5 µg/kg or less.

Vegetable fats and oils

The USA reported non-detectable levels (i.e., below 30 or 50 µg/kg) in refined vegetable oil and margarine. Canadian data on vegetable fats and oils indicate median levels below the limit of detection (i.e., 1 µg/kg). Swiss data on vegetable fats and oils for the period 1971-78 show wide variations in the levels of DDT complex (medians from below 0.1 to 28 µg/kg). Taken as a whole, the levels in imported products were higher than those in domestic Swiss products and the levels at the end of the period (1976-78) were generally lower than those at the beginning (1971-75). Switzerland reported median levels of 18 µg/kg and 26 µg/kg in cacao butter and wheat germ oil, respectively. Higher levels were reported by Hungary for sunflower seed oil (median 62 µg/kg for 1971).

Fresh fruit and vegetables

Data from Japan, New Zealand, Switzerland, and the USA show that the median levels of DDT complex in virtually all the fresh fruit and vegetables studied throughout the period were low, in most cases below the limit of detection (Japan 1.0 or 0.5 µg/kg, New Zealand 10 µg/kg, Switzerland 3 to 10 µg/kg, USA 3 µg/kg). Relatively high levels (median up to 4.5 mg/kg) were reported in some unwashed fruit and vegetables from Egypt. Median levels reported by Guatemala were in general below 10 µg/kg.

Animal fats other than milk fat

Data on DDT complex in animal fats were reported from Hungary, Ireland, the Netherlands, and Switzerland. The Swiss data for cattle fat of domestic origin show a decline in levels from 1974 to 1976 and a similar tendency is seen in the data on animal cooking fat from the same country. The level in animal cooking fat reported for 1977 from the Netherlands was much higher than those reported by the other countries.

Whole fluid cow´s milk and cream

Data on the levels of DDT complex in the fat of cow's milk were reported from Brazil (cream), Canada, Egypt, the Federal Republic of Germany, Guatemala, Hungary, Ireland, Japan, Kenya, the Netherlands, Switzerland, and the USA. Much of the data on DDT in cow´s milk refers to samples that are representative of only part of the country concerned. The data from Guatemala, referring to a special study, have been discussed in detail in the first Summary Report.

The median levels of DDT complex in the fat of cow´s milk, reported from the Federal Republic of Germany for 1977 and 1978, were 20-26 µg/kg. These are similar to the level reported from the Netherlands for 1976 and 1979. The median levels in Japan, having decreased from 160 µg/kg in 1971 to 30 µg/kg in 1975, have fluctuated between 31 and 41 µg/kg during 1976-79. The levels in milk samples, representative of the whole of Hungary, were below the limit of detection (33 µg/kg) in 1976 and 1977. Except for 1972 and 1973, all the median levels reported by the USA have been below the limit of detection (30 or 50 µg/kg).

Relatively high levels of DDT complex in milk fat were reported for 1979 for some parts of Brazil (median level 220 µg/kg) and Egypt (median level 150 µg/kg), but they are not representative for the whole of the countries concerned.

Whole dried cow's milk

Data on whole dried cow's milk were reported from Brazil, Egypt, Japan, the Netherlands, and Switzerland. As might be expected, in most cases the levels of DDT complex in dried milk reflect the levels in fluid cow's milk, when they are from the same source.

Butter and butter oil

Data on the levels of the DDT complex in butter and butter oil were submitted by Denmark, the Federal Republic of Germany, Guatemala, Hungary, Japan, Sweden, Switzerland, the United Kingdom, and the USA. In Denmark, Sweden, Switzerland (Fig. 1) and the United Kingdom, there has been a decline in levels during the period studied. Almost all the data received from the USA on domestic butter show levels below the limit of detection (30 or 50 µg/kg) throughout the period studied (1971-78). All the countries except Guatemala report median levels between less than 10 and 50 µg/kg, after 1976. Guatemala reported a median level of 0.6 mg/kg for samples collected in 1979.

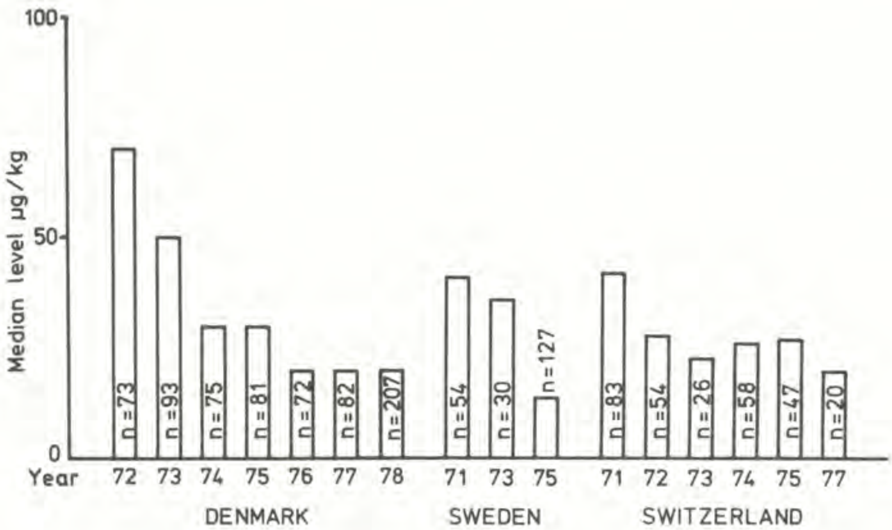


Fig. 1. Median levels of the DDT complex in the fat of butter. Samples representative of the whole of the country concerned, n = number of samples.

Human milk

Data on the levels of DDT complex in human milk were supplied by Austria, Canada, the Federal Republic of Germany, Guatemala, Hungary, Japan, Sweden, Switzerland, and the USA. However, many of the data refer to samples representative of only part of the countries concerned.

The data from Austria and the Federal Republic of Germany are expressed on a fat basis, whereas all the other data are on an "as is" basis. The data from the Federal Republic of Germany should be multiplied by a factor of 0.036 to give the results on an "as is" basis. The Austrian data show levels more than twice those in the neighbouring Federal Republic of Germany for the same year (1978). (Fig. 2)

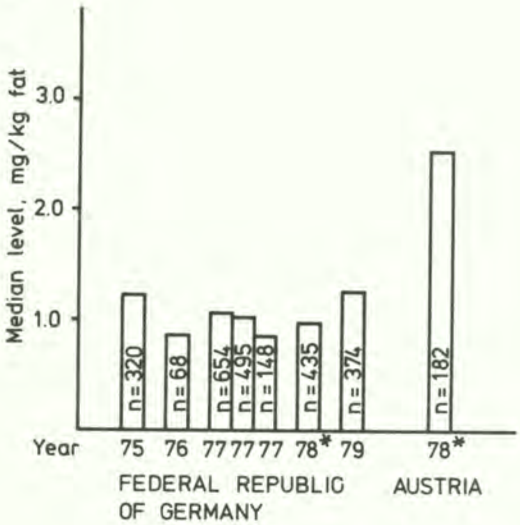


Fig. 2. Median levels of DDT complex in human milk. (n = number of samples, * = samples representative of only part of the country.)

The Swedish data for 1971-77 are for bulked samples from the Stockholm area and show a decline in levels from 1971 to 1976. The Japanese data show a downward trend in levels between 1973 and 1978. The median level for 1975, reported from the USA, is about double that reported from neighbouring Canada. The levels reported for different parts of Hungary for 1978 vary widely (median 150-530 µg/kg). The data for 1974 for different areas in Guatemala show relatively high levels (medians 0.4 and 1.4 mg/kg) (first Summary Report).

In addition to the data on the DDT complex, data on individual compounds (*p,p'*-DDT, *o,p'*-DDT, *p,p'*-DDE and *p,p'*-TDE) in human milk have been received from Canada, Japan, Mexico, the Netherlands, Sweden, Switzerland, and the USA. (The Mexican data are expressed on a fat basis whereas the other data are on an "as is" basis.) The data indicate that the major component of the DDT complex in human milk (as in foods of animal origin) is the metabolite *p,p'*-DDE. For example, the median level of the DDT complex in Canadian human milk in 1975 was 34 µg/kg. In the same study the median levels of *p,p'*-DDE and *p,p'*-DDT were 26 µg/kg and 5 µg/kg, respectively. Data from the Netherlands for 1972 show the following median levels: *p,p'*-DDT 24 µg/kg, *o,p'*-DDT 17 µg/kg, *p,p'*-DDE 54 µg/kg and TDE 3 µg/kg.

In countries in which the use of DDT for all or most purposes is prohibited, the major route of intake of DDT complex is via foods of animal origin. Thus, it can be expected that, in these countries, the ratio of DDE to DDT in human milk will continue to rise.

Hen eggs

Data on DDT complex in hen eggs were supplied by Denmark, Japan, the Netherlands, Switzerland, and the USA. The Japanese data show a decline in levels between 1974 and 1978 and the Swiss data on domestic eggs show lower median levels in 1978 than in 1971, though they never exceeded 10 µg/kg. The data from the USA show that the median levels there have been below the limit of detection (3 or 50 µg/kg) throughout the period 1972-79.

Fish

Data on DDT complex in different types of finfish were supplied by Denmark, Guatemala, Japan, the Netherlands, Switzerland, and the USA. The Danish data for 1977 show median levels in samples from different fishing grounds varying from below the limit of detection (10 µg/kg) to 630 µg/kg, with higher levels in herring than in cod. The data for domestic fish from the USA show high levels during the earlier part of the period studied (1971-73) and median levels near or below the limit of detection (30 µg/kg) at the end (1977-79). Japanese data show wide variations in the levels of DDT complex in fish from different water areas. However, the median levels reported by Japan since 1975 for marine fish are below 25 µg/kg.

3.1.2.2 Status of, and trends in the levels of the DDT complex in food

The levels of the DDT complex in cereals, fruits, vegetables, and vegetable fats and oils, reported from developed countries for the period 1971-79, were in general low, in most cases the median levels were below the limit of detection, and no trends were discernible.

The data show that during the period studied there has been a marked decline in the levels of DDT complex in the fat of cow´s milk in Japan and the Netherlands; this is illustrated in Fig. 3. The data from Canada, the Federal Republic of Germany, Switzerland, and the USA show relatively low levels throughout the period reported on.

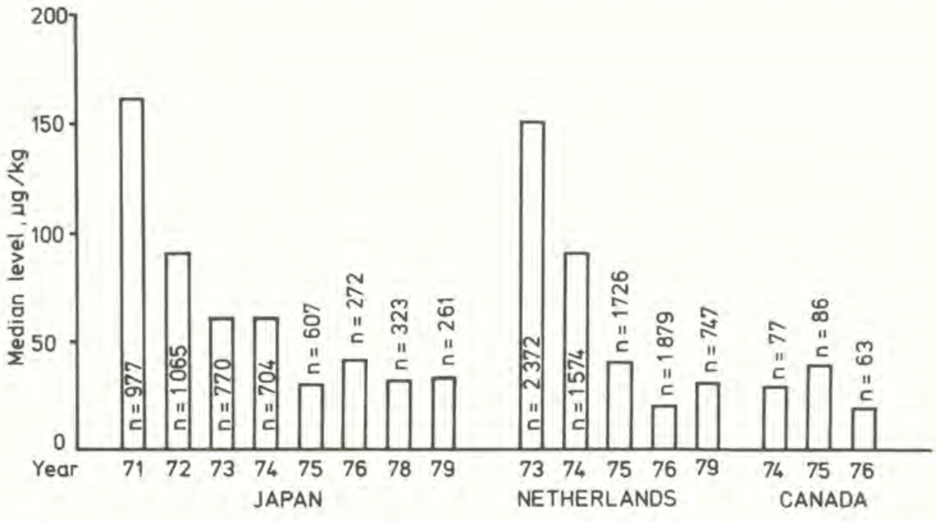


Fig. 3. Median levels of the DDT complex in the fat of cow´s milk. Samples representative of the whole of the country concerned, n = number of samples.

As would be expected from the above results on the fat of cow´s milk, the overall trend in the levels of the DDT complex in butter fat in the countries submitting data was downwards. This is illustrated in Fig. 1 with data from Denmark, Sweden, and Switzerland.

Swiss data indicate that there was a decline in the levels of DDT complex in cattle fat during the period studied and Hungarian data on pork fat show a similar tendency.

The data from Japan on DDT complex in human milk show a rise in levels from 1971 to 1973, followed by a decline from 1974 to 1979 (Fig. 4). The data from Sweden show a decline in median levels from 1971 to 1979.

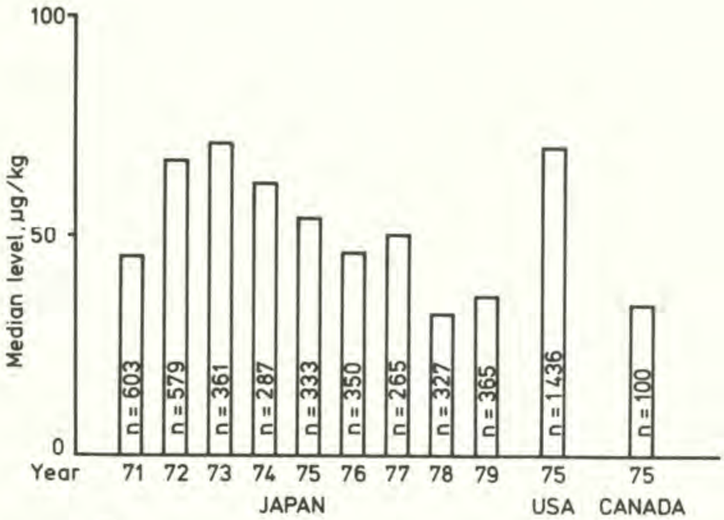


Fig. 4. Median levels of the DDT complex in human milk expressed on an "as is" basis. Samples representative of the whole of the country concerned, n = number of samples.

Data from Japan show a steady decline in the levels of DDT complex in eggs during the period 1974-78. (Fig. 5).

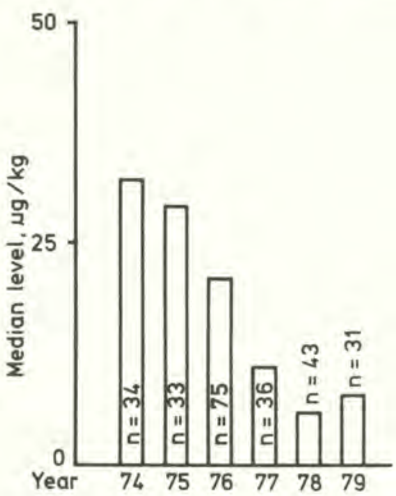


Fig. 5. Median levels of DDT complex in hen eggs from Japan (shell-free basis). Samples representative of the whole of the country, n = number of samples.

The data from the USA show a decline in the levels of DDT complex in domestic finfish from 1972 to 1979. (Fig. 6.) A similar trend is seen in the Japanese data on finfish from marine waters during the period 1971-79.

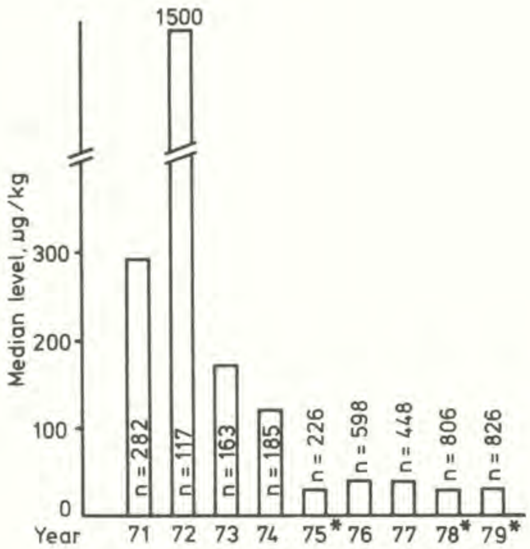


Fig. 6. Median levels of DDT complex reported from the USA for fresh domestic finfish. Samples representative of the whole of the country. n = number of samples, * = limit of detection.

Levels of DDT complex in foods, reported from developing countries, are in many cases higher than those from developed countries. However, at this stage insufficient data have been submitted to establish trends.

3.1.2.3 Assessment of monitoring data

As can be seen from the data submitted, with the exception of unwashed samples of fresh fruit and vegetables from Egypt and whole fluid cow´s milk from some areas in Guatemala, virtually none of the median or 90th percentile levels reported are above the Codex residue limits (Appendix IV).

The reported levels of the DDT complex in human milk are considerably higher than those in cow´s milk. There is a need to study more widely the levels of DDT in human milk, to identify the sources of contamination, and to evaluate the health implications, if any, of the elevated levels sometimes found. (The data on human milk are further discussed in section 4.4.)

3.1.3 Hexachlorocyclohexane (HCH) isomers

Technical grade hexachlorocyclohexane (HCH), or benzenehexachloride (BHC) consists of a mixture of a number of stereo-isomers, alpha-, beta-, gamma- and delta. Technical HCH and preparations consisting of about 99 % γ-HCH (lindane) have been (and in some countries still are) widely used in agricultural and veterinary practice, as well as in public health, food storage, and elsewhere.

Residue limits in various commodities and an ADI of 0.01 mg/kg body weight (Annex IV) have been established for lindane only (gamma-HCH). Since it is not known what proportion of the total HCH isomers reported by the Collaborating Centres is the gamma-isomer, it is not possible to relate in any way the residue limits for this one isomer to the values for the total isomers found in various foods.

3.1.3.1 Summary of monitoring data (total HCH isomers)

Cereals and cereal flours

Data from Kenya, Switzerland, and the USA on wheat, rice, and maize show median levels of HCH isomers that are below the limit of detection (1 µg/kg). Japanese and Swiss data on mixed grain also show generally low levels, with lower levels at the end of the period than at the beginning.

Vegetable fats and oils

Data from Canada and the USA on total HCH isomers in vegetable fats and oils and margarine show virtually all median levels to be below the limit of detection (1, 15 or 20 µg/kg). Swiss data show generally higher levels of HCH in imported vegetable fats and oils than in domestic products. Swiss data from 1977 on imported cacao butter and wheat germ oil show relatively high total HCH levels (medians 90 µg/kg and 146 µg/kg, respectively).

Fresh fruit and vegetables

Data from Guatemala, Japan, New Zealand, Switzerland, and the USA on HCH-isomers in fresh fruit and vegetables show levels that, in nearly all cases, are below the limit of detection (10 µg/kg or less).

Animal fat (excluding milk fat)

Total HCH levels in domestic cattle fat reported by Switzerland declined from 1974 to 1976. However, levels in domestic, animal cooking fat from the same country do not show any consistent trend (decline between 1973 and 1975 but much higher levels in 1978). Data from the Netherlands on 2 568 samples of animal cooking fat show a median HCH level of 40 µg/kg, in 1977. Data on HCH in pork-fat, reported from Hungary, suggest a marked decline in levels between 1971 and 1976.

Whole fluid cow's milk and cream

Data on total HCH isomers in the fat of cow's milk were submitted by Brazil (cream), Canada, Hungary, Ireland, Japan, Kenya, the Netherlands, Switzerland, and the USA. The Canadian data show little change in levels during the period 1974-76, the median levels being between 9 and 13 µg/kg. Data from the USA show all levels to be below the limit of detection (20 µg/kg). The Japanese data on samples representative of the whole country show a steady decline in HCH levels from 1971 (median 1.49 mg/kg) to 1979 (median 67 µg/kg). Data from the Netherlands on a large number of samples, collected during 1973-79, show median levels of 40-70 µg/kg. The

Swiss data show quite large variations between the levels in different parts of the country. The median levels reported for domestic milk for the period 1971-78 were mostly in the range 30-90 µg/kg. In general, the levels in imported milk are higher than those in the domestic product. Data from Brazil show relatively high HCH levels (median 220 µg/kg fat for 1977), but the samples are representative of only part of the country.

Whole dried cow's milk

Data on the levels of HCH in the fat of whole dried cow's milk were supplied by Brazil, Japan, the Netherlands, and Switzerland. As was the case with butter and milk fat, the median HCH level in Japanese dried milk in 1971 was high (0.63 mg/kg). The Swiss data show much lower HCH levels in 1976-77 than in 1974-75. The median HCH levels reported by the Netherlands for 1972 and 1975 were the same (50 µg/kg). The levels reported for certain parts of Brazil show a decline from 1977 (190 µg/kg) to 1979 (96 µg/kg); they are however higher than those reported by the other countries for 1975-77.

Butter and butter oil

Data were supplied by Denmark, Guatemala, Hungary, Japan, Sweden, Switzerland, the United Kingdom, and the USA. Danish and Swedish data show in general lower HCH levels in later years. Swiss data show somewhat lower HCH levels in 1977 than in 1971-75. HCH levels reported from the USA were below the limit of detection (15-20 µg/kg) throughout the period 1971-78. Although the samples are not representative for the whole country, the Japanese data show a steady and marked decline in HCH levels in butter between 1971 and 1975. Data from the United Kingdom show median HCH levels between 40 and 70 µg/kg over the period 1972-76.

Human milk

Data were supplied by Canada, Guatemala, Hungary, Japan, Sweden, Switzerland, and the USA. Most of them refer to samples that were representative of only part of the country concerned. The Canadian data show a median level below the limit of detection (1 µg/kg) for 1975. Median levels below 10 µg/kg were reported from Guatemala, and Sweden, and from a large study in the USA in 1975. The Japanese data show a steady decline in median HCH levels from 71 µg/kg in 1972 to 29 µg/kg in 1978. The Hungarian data for 1978 show median HCH levels varying from 7 to 32 µg/kg in samples from different parts of the country.

Hen eggs

Data on HCH levels were supplied by Denmark, Ireland, Japan, the Netherlands, Switzerland, and the USA. Low levels (median values in most cases below 5 µg/kg) were reported from all these countries.

Fresh finfish

Data were supplied by Guatemala, Japan, the Netherlands, Switzerland, and the USA. The data from the Netherlands and the USA show median levels below the limit of detection (10 or 20 µg/kg). Other countries also reported low levels (median values below 10 µg/kg in most cases).

3.1.3.2 Summary of monitoring data (individual HCH-isomers)

In addition to the above data on total HCH-isomers, data on individual isomers have been submitted. Although some of these data were not specifically requested (except for human milk) they are summarized below.

Gamma-HCH

Data from the Federal Republic of Germany show low levels of gamma-HCH in whole wheat and rye grain (highest median value 6 µg/kg) with a decline in levels from 1975 to 1978. The United Kingdom report levels below the limit of detection (2 µg/kg) in wheat. Similarly, levels reported in potatoes from the USA were below the limit of detection. The fat of whole fluid cow´s milk from some parts of the Federal Republic of Germany contained higher γ-HCH levels in 1977 and 1978 (medians up to 25 µg/kg) than the figure reported from the Netherlands for 1976 (below 10 µg/kg). The levels reported for human milk for the whole of the Federal Republic of Germany showed a downward trend from 1975 to 1979. However, the levels in 1978 were higher than that reported for the same year for part of Austria. (The data on human milk of both these countries are on a fat basis.) Data from the Netherlands for 1972 show γ-HCH levels below the limit of detection (3 µg/kg) whereas data from part of Hungary show median levels of 20 µg/kg for 1976.

Beta-HCH

Data on beta-HCH levels in human milk from the Federal Republic of Germany for the period 1975-77 show no clear trend, with median levels ranging from 68 to 250 µg/kg fat. The levels of beta-HCH in samples from the Federal Republic of Germany are much higher than those of the alpha- or gamma-isomers. Data from Canada for 1975 show a median level below the limit of detection (1 µg/kg) and data from the Netherlands for 1972 show a median level of 10 µg/kg. Median levels of 3 and 8 µg/kg were reported by Sweden and Switzerland respectively. Mexico reported a median level of 95 µg/kg fat for 1976.

Alpha-HCH

As with the other HCH isomers, there is no obvious trend in the levels of α-HCH in human milk reported from the Federal Republic of Germany over the period 1975-77. The median levels reported were between 38 and 46 µg/kg fat. Low α-HCH levels in human milk were reported from the Netherlands, Mexico (expressed on a fat basis), and Switzerland.

3.1.3.3 Status of, and trends in the levels of HCH isomers in food

The data from Japan on total HCH in mixed grain show a decrease in levels since 1971. The data on fruit and vegetables do not reveal any marked trends in levels of contamination. The data on total HCH in the fat of whole fluid cow´s milk samples, representative of the whole of Japan, show a progressive decline in levels from 1971 to 1979 (Fig. 7). The data from Canada, the Netherlands, and the USA are also shown on Fig. 7 for comparison. As can be seen, Canada and the USA have had low levels of HCH in milk throughout the period studied.

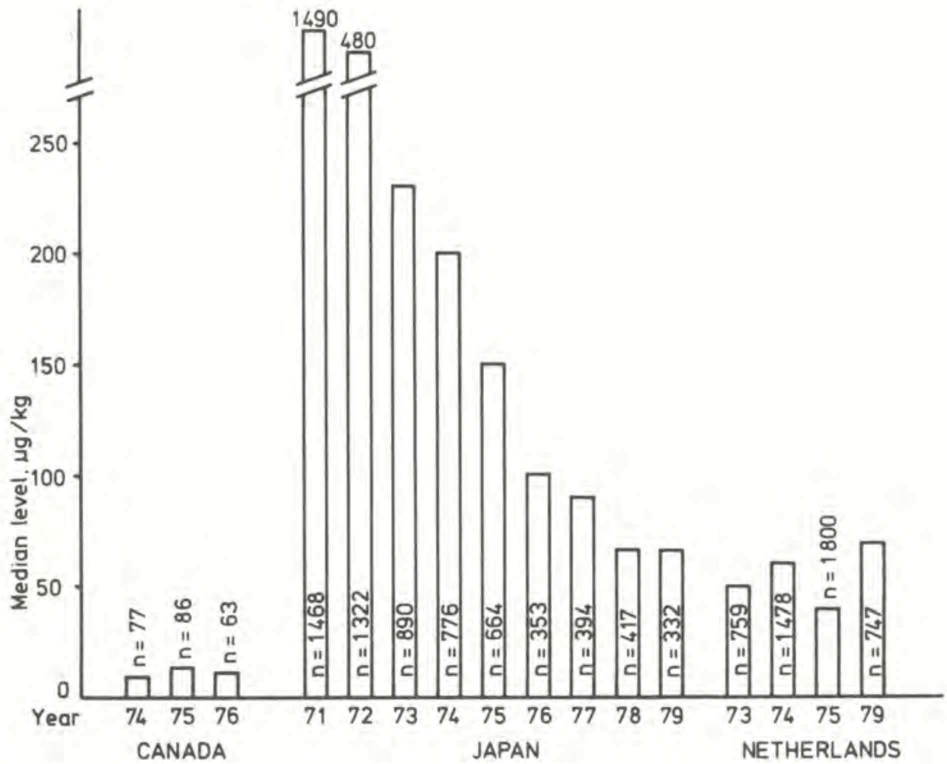


Fig. 7. Median levels of total HCH-isomers in the fat of cow´s milk. Samples representative of the whole of the country concerned. n = number of samples. Data from the USA show levels below 20 µg/kg throughout the period 1971-79.

Danish and Swiss data show lower total HCH levels in butter in 1977 than in 1972 (Fig. 8). For comparison the data from Sweden, and the USA are shown on the same figure.

Japanese data show a decline in total HCH levels in human milk from 1973 to 1978 (Fig. 9). The median levels of total HCH isomers reported by Canada and the USA for 1975 were much lower than that reported from Japan for the same year (Fig. 9). No clear trend can be seen in the data on gamma-HCH from the Federal Republic of Germany (levels are expressed on a fat basis) (Fig. 10).

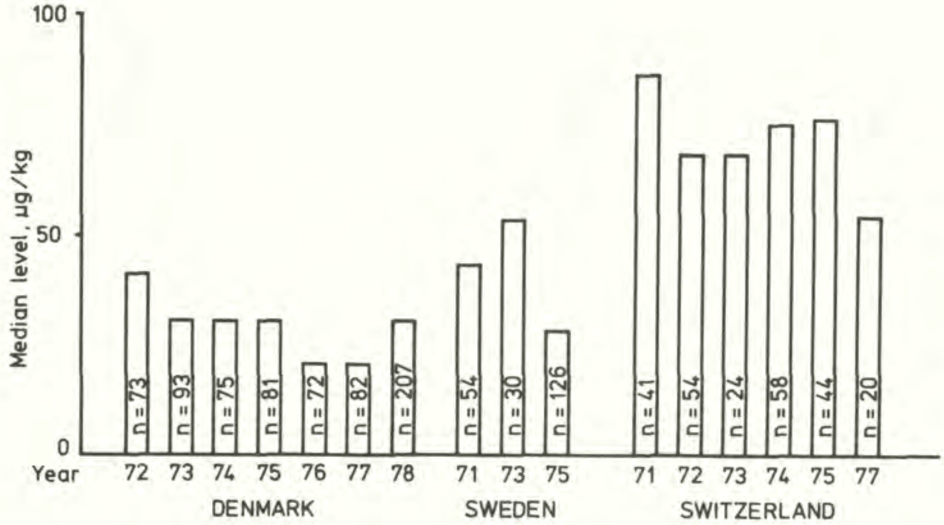


Fig. 8. Median levels of total HCH isomers in butter fat. Samples representative of the whole of the country concerned. n = number of samples. Data from the USA show levels below 20 µg/kg throughout the period 1971-78.

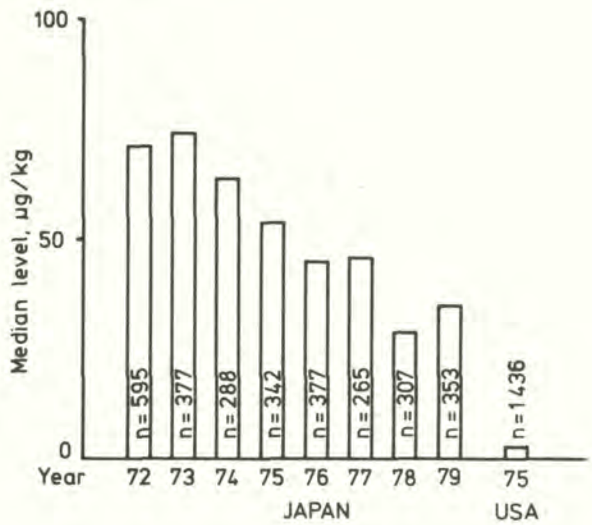


Fig. 9. Median levels of total HCH isomers in human milk expressed on an "as is" basis. Samples representative of the whole of the country. n = number of samples. Canada reported levels below 1 µg/kg for 1975 (n = 100).

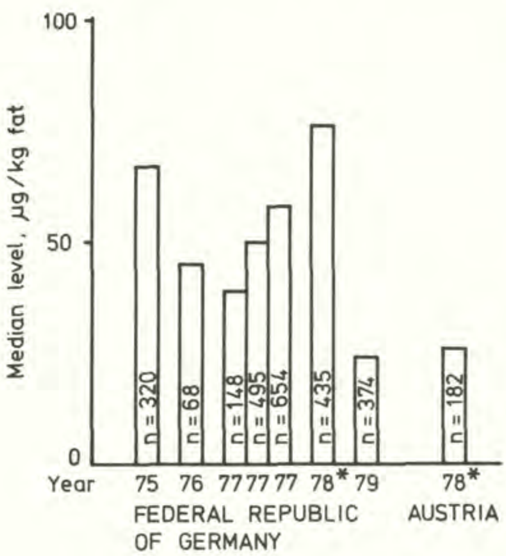


Fig. 10. Median levels of gamma-HCH in human milk. All samples except those marked with an asterisk are representative of the whole of the country. n = number of samples.

In Japan, the total HCH median levels in eggs increased from 1972 to 1974 and decreased thereafter (Fig. 11). However, the levels have been low throughout the period studied.

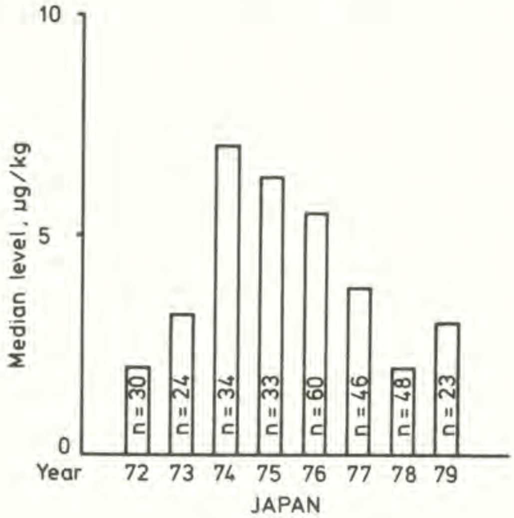


Fig. 11. Median levels of total HCH isomers in hen eggs. Samples representative of the whole of the country. n = number of samples. In the USA the median levels have been below the limit of detection (1 µg/kg) throughout the period 1971-77. Similarly, the median levels in domestic eggs reported by Switzerland for 1975-77 were below the limit of detection (3 µg/kg).

It is noteworthy that during the period studied the levels of total HCH isomers in many foods of animal origin have been considerably higher in Japan than in the European countries and that low levels have been reported throughout the period from North America. In Japan, technical HCH, containing α-, β-, δ-, and γ-isomers was widely used for pest control on rice crops until about 1971. The rice straw was extensively used as animal feed and this may have caused the high levels in food. The β-isomer accounts for about 75 % of the residual HCH in cow´s milk.

Gamma-HCH levels in wheat and rye in the Federal Republic of Germany decreased between 1975 and 1978 (Fig. 12).

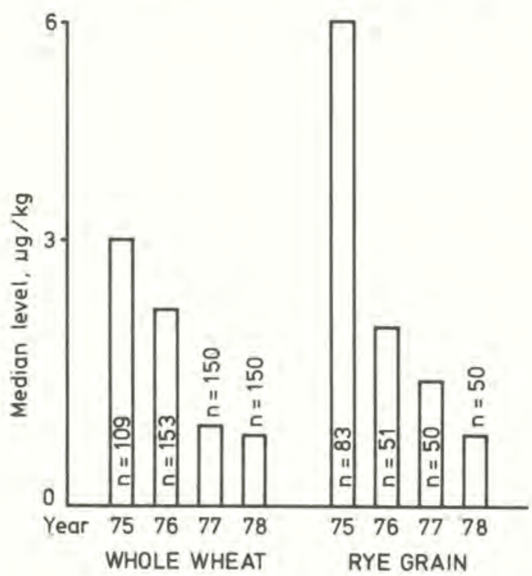


Fig. 12. Median levels of gamma-HCH in whole wheat and rye grain in the Federal Republic of Germany. Samples representative of the whole of the country. n = number of samples.

Data from the Federal Republic of Germany, Mexico, the Netherlands, and Switzerland on the levels of different HCH isomers in human milk show that the predominant isomer is β-HCH. Results submitted by the Federal Republic of Germany for 1977, on 495 samples show median levels of 46, 250, and 50 µg/kg fat for the α-, β- and γ-isomers, respectively.

3.1.3.4 Assessment of monitoring data

Inspection of the data submitted by the Collaborating Centres shows that the reported gamma-HCH levels are below the residue limits given in Annex IV. Data from Austria and the Federal Republic of Germany on gamma-HCH in human milk are expressed on a fat basis, and it can be seen that the median values do not exceed the residue limit of 0.1 mg/kg for cow's milk. However, some of the 90th percentile values reported by the Federal Republic of Germany exceed this residue limit.

3.1.4 Heptachlor and its epoxide

The widest application of heptachlor occurred up until 1960 when it was used on forage, cereal and seed, vegetables, sugar beet, and some nut crops. Since then, there has been a gradual reduction in the scale and pattern of use for various reasons, including the desire to reduce the resultant contamination of milk and animal products.

The ADI for heptachlor and its epoxide has been established as 0.0005 mg/kg body weight. Within the Joint FAO/WHO Food Standards Programme, residue limits have been established for the sum of heptachlor and its epoxide in various food commodities (Annex IV).

3.1.4.1 Summary of monitoring data

Cereals and cereal flours

Data from Japan, Switzerland, and the USA show low median levels, in nearly all cases below the limit of detection (i.e., below 3 µg/kg).

Vegetable fats and oils

Data from Canada, Guatemala, Switzerland, and the USA show low median levels, in most cases below the limit of detection.

Fresh fruit and vegetables

Data from Guatemala, Japan, Switzerland, and the USA show virtually all levels to be below the limit of detection (1-2 µg/kg).

Animal fats (other than milk fat)

Data from Switzerland show median levels, mostly below 5 µg/kg, in cattle fat, animal cooking fat, hen fat, and pork fat. The Netherlands reported a median level of 20 µg/kg for cooking fat samples taken in 1977.

Whole fluid cow´s milk

The data from Canada and the USA on heptachlor and its epoxide in milk fat show all median levels to be below the limit of detection (Canada 1 µg/kg, USA 10 or 30 µg/kg). The median values reported from Japan during the period 1971-79, for samples representative of the whole country, did not exceed 5 µg/kg. Data from the Netherlands show levels between 20 and 50 µg/kg, but no time trend. The data from Ireland and Switzerland show low levels, in most cases below the limit of detection. Data from the Federal Republic of Germany on heptachlor epoxide show median levels between 2 and 5 µg/kg fat for 1977-78.

Whole dried cow´s milk

Data were supplied by the Netherlands and Switzerland. The former reported a median level of 30 µg/kg fat for 1975 and the latter, median levels below 1 µg/kg for 1973-77.

Butter

Data on butter were submitted by Denmark, Guatemala, Japan, Switzerland, and the USA. All the median levels reported by Denmark, Guatemala, and the USA were below the limit of detection (1-30 µg/kg). Median levels below 10 µg/kg were reported from Switzerland. The median levels reported from Japan were between 15 and 24 µg/kg for the period 1971-75. Data from the Federal Republic of Germany and Switzerland for heptachlor epoxide show median levels of 3.6 and 6 µg/kg, respectively.

Human milk

Data were submitted by Austria, Guatemala, Japan, Kenya, Switzerland, and the USA. Low levels were reported by all these countries, most median levels being at, or below, 3 µg/kg on a fresh weight basis.

Data on heptachlor epoxide in human milk were reported by Canada, the Federal Republic of Germany, Mexico, the Netherlands, Switzerland and the USA. The data from the Federal Republic of Germany show a decrease in median levels from 94 µg/kg in 1975 to 8 µg/kg in 1979 (results on a fat basis). Data from the other countries show median levels below 5 µg/kg milk.

Hen eggs

Data were reported by Denmark, the Netherlands, Switzerland, and the USA: in all cases the levels were below the limit of detection.

Fresh finfish

Data were supplied by Guatemala, Japan, the Netherlands, Switzerland, and the USA. Virtually all the levels reported were low, in most cases below the limit of detection, which varied from 0.1 µg/kg to 30 µg/kg.

3.1.4.2 Status of, and trends in the levels of heptachlor and its epoxide in food

The levels of heptachlor and its epoxide reported for most foods are very low, in most cases below the limit of detection, and it is not possible from the data submitted to detect any trends in levels.

3.1.4.3 Assessment of monitoring data

With the exception of the 90th percentile value for milk from the Netherlands in 1974, all the reported levels are below in most cases far below, the residue limits quoted in Appendix IV.

3.1.5 Aldrin and dieldrin

The major use of aldrin is as a broad spectrum insecticide, primarily for the control of a wide range of soil pests, grasshoppers, and certain cotton pests. Many countries have now restricted the use of this compound. Aldrin is oxidized to dieldrin in plants and animals and in the soil.

While no separate ADI has been established for aldrin, a total aldrin plus dieldrin ADI of 0.0001 mg/kg body weight has been recommended by the Joint Meeting of the FAO Panel of Experts on Pesticide Residues and the Environment and the WHO Expert Group on Pesticide Residues. Within the Joint FAO/WHO Food Standards Programme, residue limits have been established for the sum of aldrin and dieldrin, expressed as dieldrin (Appendix IV).

3.1.5.1 Summary of monitoring data

Cereals and cereal flours

Data have been submitted by Guatemala, Japan, Kenya, Switzerland, and the USA. The median levels reported are in nearly all cases below the limit of detection.

Vegetable fats and oils

Most of the median levels reported by Canada, Switzerland, and the USA for maize oil, refined vegetable oil, vegetable fats and oils, margarine, cacao butter, and wheat germ oil are below the limit of detection.

Fresh fruit and vegetables

Data from Guatemala, Japan, New Zealand, Switzerland, and the USA show low levels, mostly below the limit of detection (0.5, 1, 3, or 10 μg/kg), in fresh fruit and vegetables.

Animal fat (excluding milk fat)

Swiss data on cattle fat show a decline in the median levels of aldrin plus dieldrin from 34 μg/kg in 1974 to 3 μg/kg in 1976. Data from the Netherlands show a median level of 30 μg/kg in animal cooking fat in 1977. Swiss data, on the same type of food, show that median levels varied between less than 3 µg/kg (limit of detection) and 12 µg/kg, during the period 1971-78. Swiss data on pork fat show a median level below 5 µg/kg.

Whole fluid cow´s milk

Data on the levels of aldrin and dieldrin in the fat of whole fluid cow´s milk were submitted by Canada, Hungary, Ireland, Japan, the Netherlands, Switzerland, and the USA. Canadian data for 1974 and 1975 show median levels below 1 µg/kg, but a median level of 12 µg/kg is reported for 1976. The Japanese data show median levels varying from 15 to 32 µg/kg in samples, representative of the whole country, taken during the period 1971-79. The data from the Netherlands show a decline in median levels from 40 µg/kg in 1973-74 to 20 µg/kg in 1979.

Large amounts of data have been provided by Switzerland for both domestic and imported milk. The data for domestic samples, representative of the whole country, show a decline in levels from 1971 to 1979. The data from the USA show that levels were below the limit of detection (15 or 50 µg/kg) throughout the period 1971-79.

Whole dried cow´s milk

Data were provided by Japan, the Netherlands, and Switzerland. As would be expected, the Netherlands´ data show levels about the same as those in the fat of whole fluid cow´s milk. The Swiss data show a decline in levels over the years 1974-77, the medians ranging from nearly 30 µg/kg in 1974-75 to less than 1 µg/kg in 1977.

Butter

Data were submitted by Denmark, Guatemala, Hungary, Japan, Switzerland, and the USA. The Japanese data show median levels below 15 µg/kg after 1971. The Swiss data show a gradual decline in median levels from 33 µg/kg in 1971 to 12 µg/kg in 1977 in domestic butter samples representative of the whole country. In the USA, the levels were below the limit of detection (50 or 15 µg/kg) throughout the period 1971-78. The median levels reported by Denmark were also below the limit of detection (10 µg/kg) throughout the period studied (1972-78).

Human milk

Data were submitted by Austria, Guatemala, Japan, and Switzerland. Beginning with 1973, a decline in median levels is seen in the data from Japan. Swiss data, representative of only parts of the country show a decrease between 1973 and 1974.

Data on dieldrin in human milk were reported by Canada, the Federal Republic of Germany, Mexico, the Netherlands, Sweden, Switzerland, and the USA. None of the median levels exceeded 3 µg/kg milk (the data from the USA showed levels below the limit of detection, 10 µg/kg).

Hen eggs

Data were submitted by Denmark, the Netherlands, Switzerland, and the USA. In most cases, the median levels reported were below the limit of detection.

Fresh finfish

Data were submitted by Guatemala, Japan, the Netherlands, Switzerland, and the USA. The median levels reported from the Netherlands and the USA were below the limit of detection (10 µg/kg for the Netherlands, 50 µg/kg for the USA). The Japanese data show median levels below 10 µg/kg in both coastal and marine finfish.

3.1.5.2 Status of, and trends in the levels of aldrin and dieldrin in food

The levels of aldrin and dieldrin reported for most foods are very low, in many cases below the limit of detection. Data on whole fluid cow's milk from Japan, the Netherlands, and Switzerland show a decline in levels over the period studied (Fig. 13) and a decline is also seen in the levels in Swiss butter between 1971 and 1977. Data on human milk from Japan and Switzerland show also a decline in level (Fig. 14). Apart from these examples, it is difficult to discern any trends in residue levels.

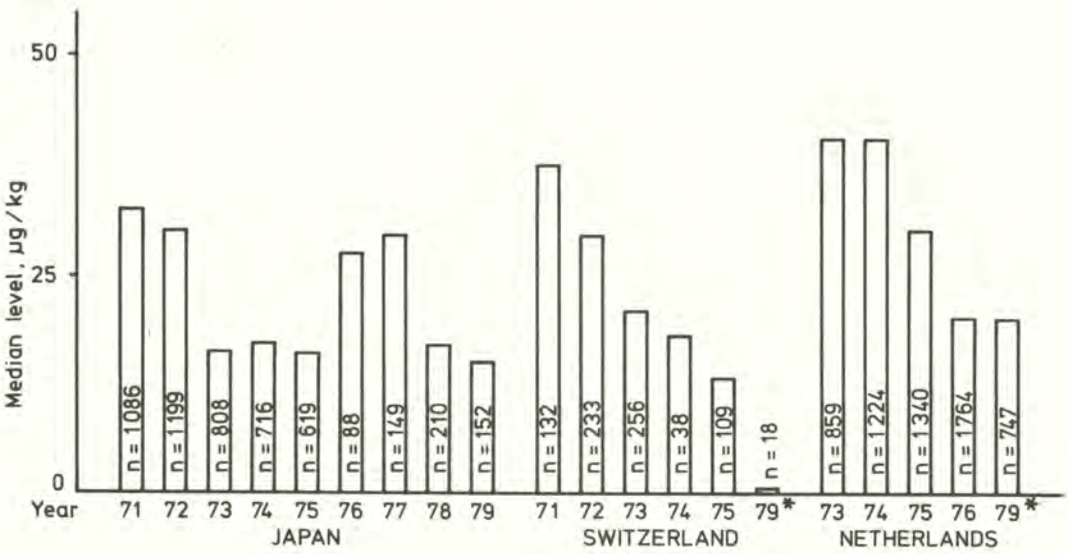


Fig. 13. Median levels of aldrin plus dieldrin in whole fluid cow's milk expressed on a fat basis. Samples representative of the whole of the country concerned. n = number of samples, * = level below limit of detection. The USA reported levels below the limit of detection throughout the period 1971-78 (limit of detection 15 or 50 µg/kg).

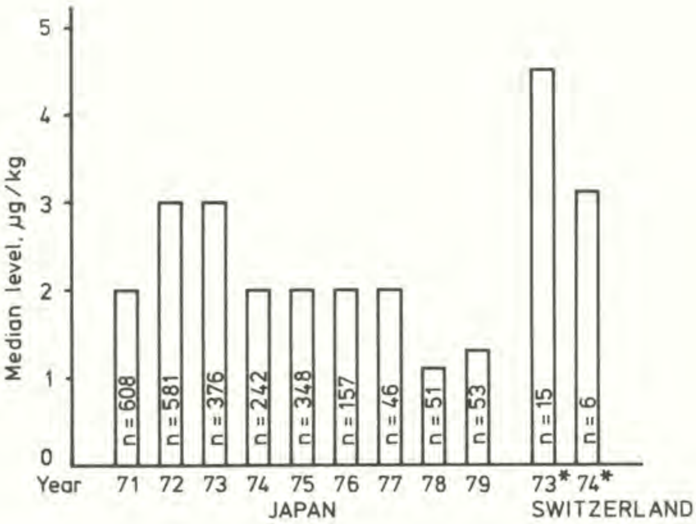


Fig. 14. Median levels of aldrin and dieldrin in human milk. n = number of samples, all samples except those marked with an asterisk are representative of the whole of the country.

3.1.5.3 Assessment of monitoring data

With the exception of a few 90th percentile values, all the reported values were lower than the residue limits, in most cases far lower.

3.1.6 Hexachlorobenzene (HCB)

Hexachlorobenzene is produced as an ingredient in formulations used for antifungal seed coatings and as a by-product in the manufacture of several non-pesticide, organochlorine chemicals. Its presence as a residue in food can thus arise from its agricultural use and from environmental pollution due to improper disposal of manufacturing waste.

A conditional acceptable daily intake of 0.0006 mg/kg body weight, previously established for HCB, was withdrawn in 1978.

Within the Joint FAO/WHO Food Standards Programme, guideline levels have been established for HCB in several food commodities (Appendix IV).

3.1.6.1 Summary of monitoring data

Cereals and cereal flours

Data supplied by the Federal Republic of Germany, Switzerland, and the USA show low levels, in most cases below 1 µg/kg or the limit of detection (USA 4 µg/kg).

Vegetable fats and oils

Data from Canada, Switzerland, and the USA show median levels below the limit of detection in most cases.

Fresh fruit and vegetables

Data from Japan, Switzerland, and the USA on various fresh fruits and vegetables show levels below the limit of detection (0.2-4 μg/kg).

Animal fat (excluding milk fat)

Data from the Netherlands and Switzerland on animal fat show wide variations in levels. The median level in Swiss cattle fat declined from 31 μg/kg in 1974 to 10 μg/kg in 1976. However, in the same country the median level in animal cooking fat in 1978 (10 μg/kg) was higher than that in 1973-75. The highest median level reported was that from the Netherlands (50 μg/kg), based on the analysis of 2 568 samples.

Whole fluid cow's milk and cream

Data on the levels of HCB in the fat of cow's milk were reported from Canada, the Federal Republic of Germany, Japan, the Netherlands, Switzerland, and the USA. The median levels reported by Canada and the USA were all below the limit of detection (1-10 μg/kg). Data reported from the Federal Republic of Germany show median values ranging from 14 to 24 μg/kg during 1977-79. The Japanese data for 1976-78 show median levels of about 6 μg/kg. Data from the Netherlands show a decline in median levels from 40 μg/kg in 1973 to 20 μg/kg in 1979. Likewise, Swiss data for domestic milk show a decline in median levels from 45 μg/kg in 1971 to 0.6 μg/kg in 1979.

Whole dried cow's milk

Data were provided by the Netherlands and Switzerland. Data from the former country show median levels of 30 and 20 μg/kg for 1972 and 1975, respectively. The Swiss data suggest a decline in median levels from 1974 to 1977.

Butter

Data were submitted by Denmark, the Federal Republic of Germany, Japan, Sweden, Switzerland, and the USA. The Danish results show an increase from a median level below 10 μg/kg in 1973 to 30 μg/kg in 1974-76, after which the median level has been 20-30 μg/kg. The data from the Federal Republic of Germany show a median level of 22 μg/kg in 1977. Swedish data show a decline in median levels from 17 μg/kg in 1971 to 9 μg/kg in 1975. The Swiss data show an increase in median levels from 18 μg/kg in 1971 to 40 μg/kg in 1974, followed by a decrease to 24 μg/kg in 1977. The data from the USA show levels below the limit of detection (4 or 10 μg/kg) throughout the period 1971-78.

Human milk

Data were submitted by Austria, Canada, the Federal Republic of Germany, Hungary, Japan, Mexico, the Netherlands, Sweden, Switzerland, and the USA. The results from Canada, Japan, Mexico, and Sweden show that all median levels were below 5 µg/kg and the results from the USA show median levels below the limit of detection, for 1974 and 1975 (10 and 1 µg/kg, respectively). The data from Austria and the Federal Republic of Germany show higher levels (even taking into account the fact that the results are expressed on a fat basis). The median level reported for the Federal Republic of Germany for 1979 (700 µg/kg fat) is higher than the levels reported for 1975-78. The Swiss results show median levels ranging from 7 to 16 µg/kg, over the period 1971-78. Data from Hungary show median HCB levels of 4-10 µg/kg in samples from different parts of the country taken in 1976 and 1978. Data from the Netherlands show a median level of 30 µg/kg for 1972.

Hen eggs

Data submitted by Switzerland and the USA show all median levels to be below 5 µg/kg, with the exception of Swiss results from 1971 on imported eggs. Denmark and the Netherlands report median values below the limit of detection.

Fresh finfish

Data were supplied by Japan, the Netherlands, Switzerland, and the USA. Almost all the levels are below 10 µg/kg.

3.1.6.2 Status of, and trends in the levels of HCB in food

Data from Switzerland show a decline in median levels for HCB in the fat of domestic cow's milk between 1971 and 1979 (Fig. 15). HCB levels in butter from Sweden declined between 1971 and 1975 and, in Switzerland, they increased between 1972 and 1974 decreasing thereafter (Fig. 16). The level reported by the Federal Republic of Germany for human milk for 1979 is higher than those for 1975-78. Apart from these examples, the data do not reveal any clear trends in the levels of HCB in the foods analysed.

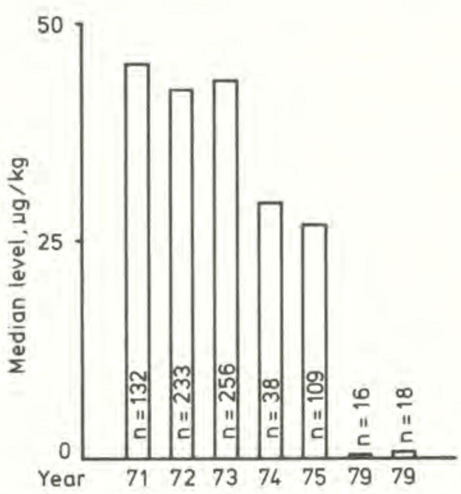


Fig. 15. Median levels of hexachlorobenzene in the fat of cow's milk from Switzerland. Samples representative of the whole of the country. n = number of samples.

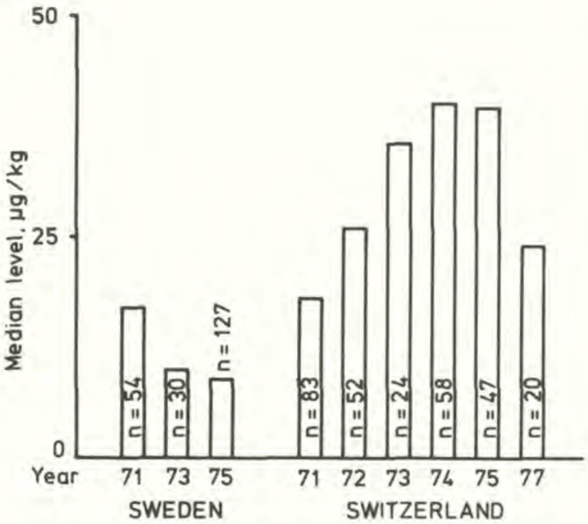


Fig. 16. Median levels of hexachlorobenzene in butter from Sweden and Switzerland. Samples representative of the whole of the country concerned.
n = number of samples.

3.1.6.3 Assessment of monitoring data

Inspection of the data submitted shows that none of the food analysed contained levels above Codex guidelines, and that in most cases they were far below them. The levels in human milk (on a fat basis) rarely exceeded the guideline level of 0.5 mg/kg for cow´s milk (fat basis).

3.1.7 Polychlorinated Biphenyls (PCBs)

The commercial production of the polychlorinated biphenyls (PCBs) began in 1930 for use: (a) as dielectrics in transformers and large capacitors; (b) in heat transfer and hydraulic systems; (c) in the formulation of lubricating and cutting oils; and (d) as plasticizers in paints, copying paper, adhesives, sealants, and plastics. In recent years, drastic restrictions in the production and use of the PCBs have been introduced in many countries.

No acceptable daily intake (ADI) or tolerable intake for man has been established for PCBs by any FAO/WHO expert group. However, an evaluation of the toxicological effects of PCBs has been published by WHO (2). According to this evaluation, man appears to be one of the most sensitive species as far as PCBs are concerned and effects have been observed at intake rates of 0.07 mg/kg body weight/day.

Because of the absence of an adequate toxicological evaluation, no limits for PCBs in food commodities have been established within the FAO/WHO Food Standards Programme.

3.1.7.1 Summary of monitoring data

Cereals

Data were submitted by Japan, Switzerland, the United Kingdom, and the USA. The United Kingdom and the USA reported levels below the limit of detection (United Kingdom 10 µg/kg, USA 100 or 700 µg/kg). With one exception, all the median levels reported from Switzerland and Japan were below 10 µg/kg.

Vegetable fats and oils

Data were submitted by Canada, Switzerland, and the USA. Canada and the USA reported all levels to be below the limit of detection (Canada 1 µg/kg, USA 700 µg/kg). With one exception (median level 37 µg/kg in imported refined vegetable oil in 1977) all the Swiss data show median levels at, or below 5 µg/kg.

Fresh fruit and vegetables

Data were submitted by Japan, Switzerland, the United Kingdom, and the USA. All the USA data show levels below 100 µg/kg (the limit of detection) and the data submitted by the United Kingdom and Switzerland also show levels below the limit of detection (10 µg/kg and 1 µg/kg, respectively). The Japanese data show median levels ranging from less than 0.5 µg/kg (the limit of detection) to 5 µg/kg.

Animal fat (excluding milk fat)

Data were supplied by Austria, the Netherlands, Switzerland, and the United Kingdom. Cattle fat from Austria contained a median level of 210 µg/kg in 1978 and Swiss data show median levels of 57-200 µg/kg during the period 1974-76. Animal cooking fat from the United Kingdom contained levels below the detection limit (10 µg/kg) whereas Swiss data show median levels from 28 µg/kg to 71 µg/kg for 1977-78 and Netherlands data show a median level of 240 µg/kg for 1977. Hen and goose fat data from Austria for 1978 show median levels of 110 and 160 µg/kg, respectively, and Swiss data show a median level of 19 µg/kg in imported hen fat for 1977.

Whole fluid cow's milk

Data on the levels of PCBs in the fat of cow's milk were supplied by Austria, Canada, Japan, the Netherlands, Switzerland, the United Kingdom, and the USA. The data from Canada, the United Kingdom, and the USA show all levels to be below the limit of detection (Canada 5 µg/kg, United Kingdom 2 µg/kg, USA 700 µg/kg). The Japanese data show a peak in PCB levels in 1972 and a decline during the period 1973-79. The Swiss data show large variations in levels, during the period 1975-78, in milk from different parts of the country and levels below the limit of detection (10 µg/kg) for 1979. The Netherlands reported a median level of 200 µg/kg for 1979 for samples representative of part of the country.

Butter

Data were submitted by Denmark, Japan, Sweden, Switzerland, and the USA. The levels reported from the USA were all below the limit of detection (700 µg/kg). The Danish data show an increase in median levels over the period 1975-77 from less than 30 to 80 µg/kg.

Whole dried cow's milk

Data supplied by Japan show levels between 20 and 50 µg/kg, over the period 1972-75.

Human milk

Data were submitted by Canada, the Federal Republic of Germany, Japan, Sweden, Switzerland, and the USA. (The data from the Federal Republic of Germany are on a fat basis and the others are on an "as is" basis). The Canadian data show a median level of 10 µg/kg for 1975. The data reported by the USA show all median levels to be below the limit of detection (0.02, 0.05 or 1 mg/kg). The Japanese data show a gradual decline in median levels from 27 µg/kg in 1972 to 18 µg/kg in 1979. Swedish data show median levels between 20 and 30 µg/kg for bulked samples collected during the period 1971-76 and 65 µg/kg in individual samples collected in 1978.

The German data, representative of the whole country, show an increase in median levels from 0.80 mg/kg fat in 1975 to 1.75 mg/kg in 1976, followed by a decline to 1.19 mg/kg in 1977 (or 42 µg/kg on an "as is" basis).

Hen eggs

Data were supplied by Denmark, Japan, the Netherlands, Switzerland, and the USA. All the Swiss and USA data show levels below the limit of detection (10, 100, or 700 µg/kg) and the Japanese data show median levels not exceeding 10 µg/kg during the period 1972-79, the levels being lower at the end of the period than at its beginning.

Fresh finfish

Data were supplied by Austria, Denmark, Japan, the Netherlands, Switzerland, and the USA. The Danish data show levels below the limit of detection (30 µg/kg) in cod and variations in levels in herring from different fishing grounds (medians from 0.08 to 0.3 mg/kg for 1977). The Austrian data show high levels (median 2.31 mg/kg) in fish from some areas of the country. Data from the Netherlands and from the USA show all median levels to be lower than the limit of detection (200 µg/kg for the Netherlands and up to 700 µg/kg for USA). Extensive Japanese data show a decline in PCB levels in fish from coastal waters and in total marine fish over the period 1971-79.

3.1.7.2 Status of, and trends in the levels of PCBs in food

Data from Denmark show an increase in PCB levels in butter fat over the period 1975-77. Data from the Federal Republic of Germany show an increase in PCB levels in human milk from 1975 to 1976 after which time no clear trend in levels can be discerned. (Fig. 17).

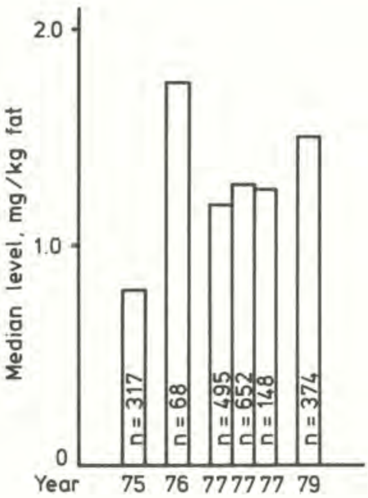


Fig. 17. Median levels of PCBs in the fat of human milk from the Federal Republic of Germany. Samples representative of the whole of the country. n = number of samples.

Japanese data show a decline in PCB levels in the fat of whole cow´s milk (Fig. 18) and in human milk (Fig. 19) during the period 1972-79. In addition, a decline is shown in PCB levels in fresh finfish from coastal waters and in total marine fresh fish (Fig. 20) in Japan.

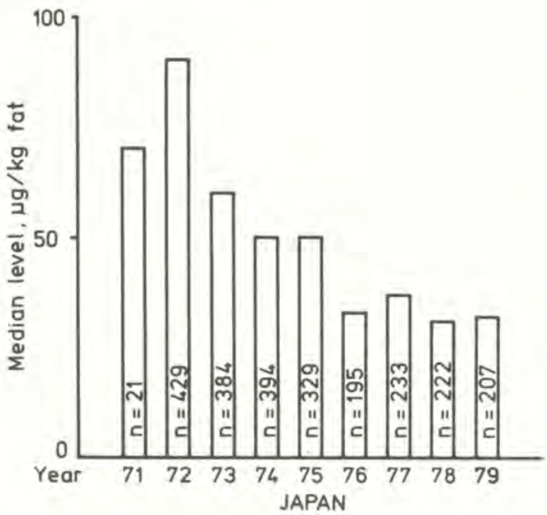


Fig. 18. Median levels of PCBs in the fat of cow´s milk from Japan. Samples representative of the whole of the country. n = number of samples.

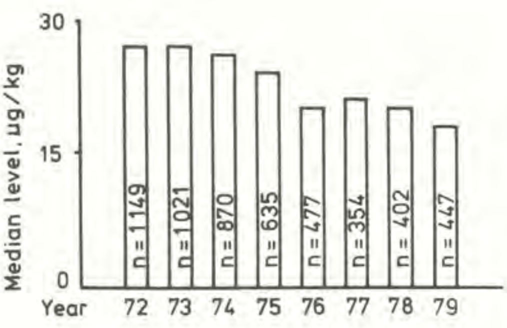


Fig. 19. Median levels of PCBs in human milk from Japan. Samples representative of the whole country. n = number of samples.

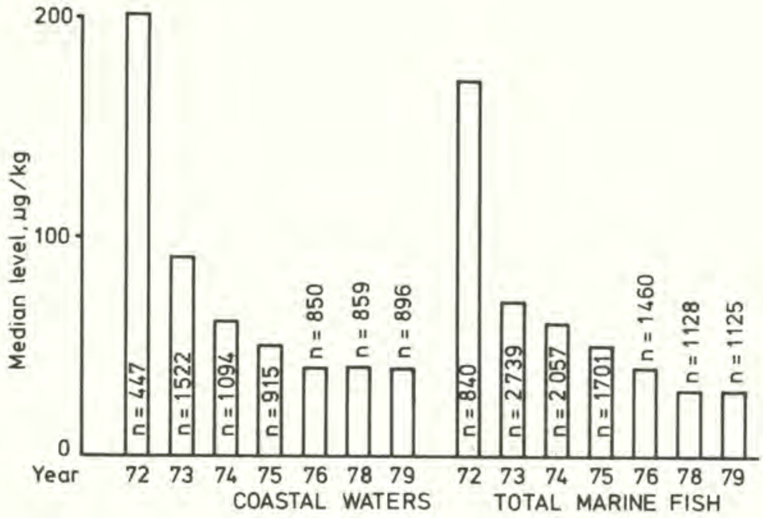


Fig. 20. Median levels of PCBs in fish from Japan. Samples representative of the whole of the country. n = number of samples.

3.1.7.3 Assessment of monitoring data

No assessment can be made at present.

3.2 HEAVY METALS

3.2.1 Analytical methods

The Collaborating Centres which have carried out lead and cadmium determinations have used the atomic absorption spectrophotometric technique preceded by acid digestion or dry ashing. In the USA, anodic stripping voltametry was also used.

3.2.2 Lead

In 1972, the Joint FAO/WHO Expert Committee on Food Additives (JECFA) established a provisional tolerable weekly intake for lead of 0.05 mg/kg body-weight for adults (equivalent to 3 mg per person). The Committee specifically pointed out that this intake level does not apply to infants and children.

The toxicology of lead has also been reviewed by a WHO Task Group (3).

Within the Joint FAO/WHO Food Standards Programme a maximum residue level of 0.3 mg/kg has been recommended for lead in a number of fruit juices.

3.2.2.1 Summary of monitoring data

As has been pointed out already (paragraph 2.4), the data collected in Stage I on lead in canned fruits, vegetables, and fruit juices have been presented in detail in the first Summary Report. The reader is referred to this report for a discussion of results not dealt with in such detail in the present report.

Quite a lot of the data on lead levels are based on the analysis of relatively few (i.e., less than 20) samples, which makes it difficult to draw any conclusions from them.

Cereals and cereal flours

Data were submitted by Canada, Guatemala, Japan, the Netherlands, Poland, Switzerland, and the USA. The US data show levels below the limit of detection. The Japanese data on mixed grain samples, representative of the whole of the country, show a decline in lead levels from 200 µg/kg in 1973 to about 30 µg/kg in 1975-79. Canadian results show a downward trend in lead levels in cereal flour over the period 1972-76.

Fresh vegetables

The data on the lead content of fresh vegetables are expressed on a fresh weight basis, except for those from Switzerland, which are on a dry weight basis. Few of the median levels exceed 70 µg/kg and many are below 50 µg/kg.

Canned vegetables

The data on lead levels in vegetables, packed in cans with lead-soldered side-seams (only results on 10 or more samples are considered), indicate that most of the median levels were in the range 0.1-1 mg/kg, although the median levels in canned tomato purée (which has a higher dry matter content than the other products) were often higher.

Fresh fruit

Data on the lead content of fresh fruit were not specifically requested, but some data were submitted by Sweden and Switzerland and can be compared with the levels in the corresponding canned products.

Canned fruit

Most of the median levels in fruit, packed in cans with lead-soldered side-seams, were in the range 0.1-0.7 mg/kg, but higher levels were reported from the United Kingdom for certain years.

Canned fruit juices

Median lead contents of fruit juices (including infant juices), packed in cans with lead-soldered side-seams (only data on 10 samples or more are evaluated) varied widely. It should be noted that some of the data refer to concentrated juices. Most of the results reported by the USA, for the period since 1976, show median levels below 0.1 mg/kg (in some cases much lower), whereas the levels reported by some other countries for the same type of product, during the same period, are often considerably higher.

Kidney

Data on fresh cattle and veal kidney were submitted by Canada, Denmark, the Netherlands, and the USA. They show median levels ranging from 0.1 to 0.48 mg/kg. Data on mutton kidney from the USA show median levels from below 0.1 mg/kg to 0.38 mg/kg. Data on pork kidney reported by Canada, Denmark, the Netherlands, and the USA show median levels from 0.06-0.26 mg/kg. Horse kidney data from the USA show median levels of 0.16 and 0.34 mg/kg for 1975 and 1976, respectively.

Fish and shellfish

Most of the data on lead levels in fish products refers to samples taken from a specific water area and thus they may not be representative for the whole country.

Finfish

Data on fresh fish submitted by Ireland and Switzerland show median levels in the range of 0.04-0.3 mg/kg. Data on canned finfish from Egypt, Ireland, and Switzerland show median levels between 0.2 and 1.2 mg/kg.

Crustaceae

Data on lead in fresh crab and lobster from different waters around the United Kingdom and the USA show median levels ranging from less than 0.1 to 1.18 mg/kg. The United Kingdom supplied separate data on lead levels in white and brown crab meat and crab body and crab claw. The lead levels were slightly higher in the brown meat than in the white meat and higher in the body than in the claw. The United Kingdom also supplied separate data on lead levels in lobster claws and tails, all the levels being below 0.2 mg/kg. Data submitted by the United Kingdom and the USA, on shrimps, show median levels from below 0.2 to 0.72 mg/kg. Irish and Japanese data on crustaceae show median levels from 0.17 to 0.34 mg/kg.

Molluscs

Data from the United Kingdom on whelks and periwinkles show median levels from 0.25 to 0.90 mg/kg.

Data on fresh oysters from different parts of Ireland, the United Kingdom, and the USA show median lead levels in the range of 0.08-0.69 mg/kg. Data submitted by Ireland, Japan, Switzerland, and the United Kingdom on fresh mussels (including horse mussels) show median levels from 0.13 to 6.3 mg/kg. Data on scallops from the United Kingdom and the USA showed median levels from below 0.1 to 5.5 mg/kg.

Data from the United Kingdom and the USA on clams show median levels from 0.3 to 0.71 mg/kg. Data on cuttlefish from the Netherlands and USA show median levels ranging from 0.2 to 0.46 mg/kg. Data on octupus and squid from the USA show median levels of about 0.6 mg/kg.

Canned milk products

According to data from the USA, lead levels are higher in evaporated milk and evaporated skimmed milk in small cans (5.33 fl. oz) than in larger cans (13 fl. oz) (see First Summary Report).

3.2.2.2 Status of, and trends in the levels of lead in food

For most of the commodities on which data have been submitted, no clear time trends in lead levels can be seen. Data for cereal flour from Canada suggest a decline in median lead levels in that country from 110 μg/kg in 1972 to 40 μg/kg in 1976. However, the number of samples is too small for any firm conclusion to be drawn. The following data suggest a downward trend in lead levels in the commodities concerned:

(*a*) Data reported from the USA suggest a decline in lead levels in canned tomatoes and canned tomato juice between 1974 and 1978 and in canned green corn between 1972 and 1977;

(*b*) Data from the USA on canned infant juices (Fig. 21) show a downward trend in levels between 1972 and 1978;

(*c*) Data supplied by the USA on canned evaporated milk and canned evaporated skim milk show a decline in lead levels between 1973 and 1978 (Fig. 22).

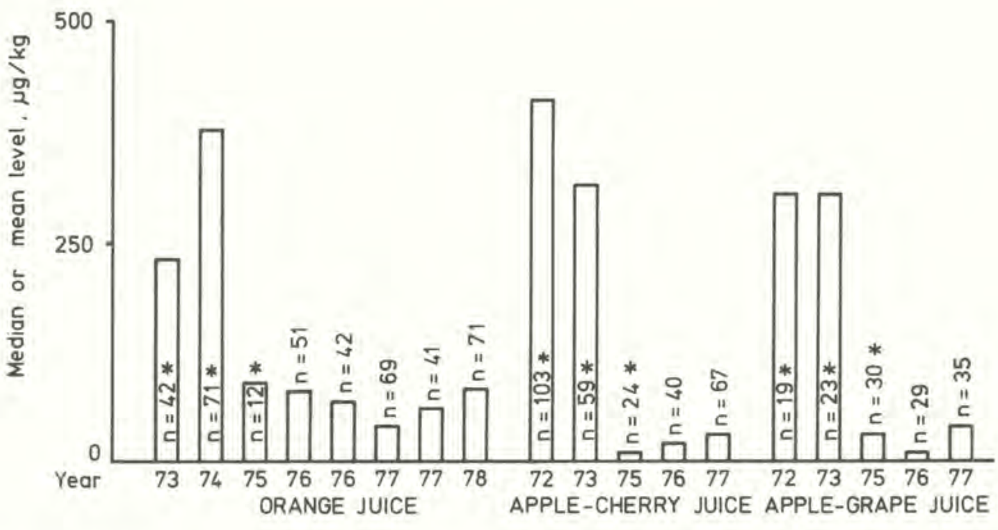


Fig. 21. Median or mean lead levels in canned infant juices in the USA. Samples representative of the whole of the country. n = number of samples, * = mean level.

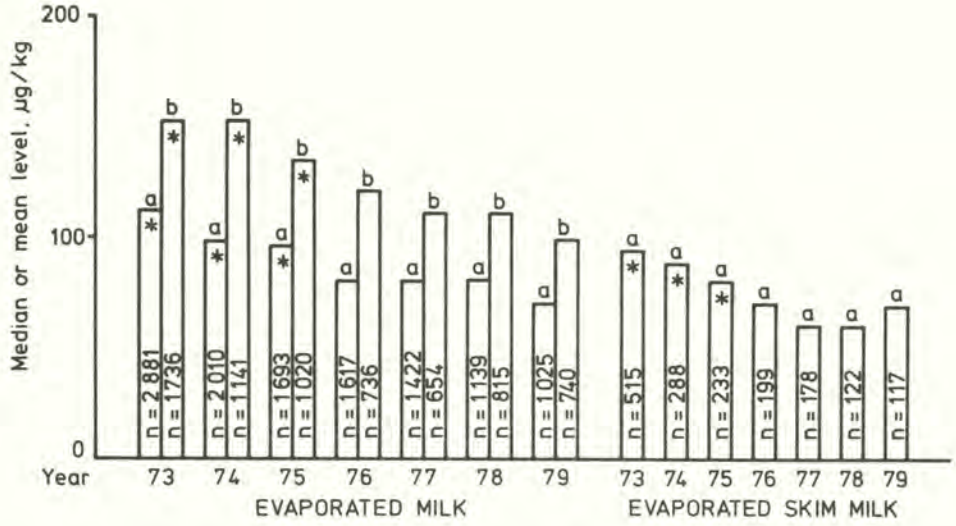


Fig. 22. Median or mean lead levels in canned evaporated milk and canned evaporated skim milk in the USA. Samples representative of the whole of the country. n = number of samples, * = mean level, a = 13 fl. oz. can, b = 5.33 fl. oz. can.

3.2.2.3 Assessment of monitoring data

As can be seen from the data reported, the Codex maximum recommended levels are exceeded in a few cases. However, these are mainly results from the first half of the 1970s, the only countries reporting high levels after 1975 being Egypt and Hungary, for orange juice.

Comparison of the data on lead levels in fresh and canned fruit and vegetables reveals that the canned products almost always contain much higher levels than the corresponding fresh product, in many cases more than 5 times as much (Table 1).

The major source of lead in foods in cans with lead-soldered sideseams is the solder (usually 98 % lead). The food control authorities in many countries (e.g., Canada, the United Kingdom, and the USA) have been aware of this problem for many years and have exerted pressure on the canning industry to improve its technology to reduce this contamination. The downward trend already mentioned in the levels of lead in canned foods for infants, seen in the data from the USA, is the result of improvements in can-making and canning practice made by the industry in response to this concern.

Improvements include cleaning up the operations of lead soldering and the lacquering of can interiors and the institution of additional quality control procedures, such as the avoidance of treating raw products with lead arsenate.

3.2.3 Cadmium

In 1972, the Joint FAO/WHO Expert Committee on Food Additives established a provisional tolerable weekly intake for cadmium of 0.4-0.5 mg for an adult (equivalent to about 7.5 µg/kg body weight, per week). No limits for cadmium have been established within the FAO/WHO Food Standards Programme for the commodities on which data have been collected.

3.2.3.1 Summary of monitoring data

Some of the data submitted on cadmium in foods refer to samples that are representative of only part of the country concerned. Furthermore, in quite a lot of cases, relatively few samples (<20) have been analysed.

Cereals and cereal flours

Data on whole wheat from the Federal Republic of Germany, Qatar, the United Kingdom, and the USA show median levels from below 10 to 93 µg/kg, most being in the range 40-60 µg/kg. Data on wheat flour from Japan, Poland, Qatar, the United Kingdom, and the USA, and on whole wheat bread from the Netherlands, show median levels ranging from 20 to 70 µg/kg. Data on rice and milled rice from the USA and the Netherlands show median levels of less than 10-20 µg/kg. The median level reported from the United Kingdom for barley was 30 µg/kg. Data on rye from the Federal Republic of Germany show a median level of 10 µg/kg for 1976 and 1977, which is the same as that reported for rye flour by Poland in 1974. The United Kingdom reported a median level of 85 µg/kg for oats. Japan and Switzerland reported data on mixed grain showing median levels from 40 to 110 µg/kg. Data on cereal flour from Canada and the Netherlands show median levels in the range of 30-40 µg/kg.

Fruit and vegetables

Hungary, Ireland, Japan, New Zealand, Poland, Qatar, Switzerland, and the United Kingdom supplied data on a variety of vegetables. However, only data on potatoes will be discussed as this was all that was requested.

Data on fresh potatoes from Canada, Denmark, Japan, the Netherlands, Poland, the United Kingdom, and the USA show median levels from less than 10 to 44 µg/kg, mostly in the range 20-40 µg/kg.

Kidney

Data on fresh cattle kidney were submitted by Canada, Denmark, the Netherlands, the United Kingdom, and the USA. The median levels ranged from 0.28 to 1.3 mg/kg. Data from the USA on veal kidney (median 0.12 mg/kg) show lower levels than in cattle kidney from the same country. Data on mutton kidney from the United Kingdom and the USA show median levels from below 0.02 to 0.16 mg/kg. Data on pork kidney were submitted by Canada, Denmark, the Netherlands, the United Kingdom, and the USA. They show median levels ranging from 0.18 to 0.92 mg/kg. Data on horse kidney from the USA show very high cadmium levels - median 28 mg/kg, 90th percentile 100 mg/kg.

Crustacea

The United Kingdom supplied separate data for white and brown crab meat and for crab body and crab claws. The samples were collected from different waters around the United Kingdom. The cadmium levels in fresh edible crab bodies were as high as 18 mg/kg. Data from the USA on various types of crab, show median levels from 0.11 to 0.25 mg/kg. United Kingdom data on lobsters show median levels from below 0.02 to 5.90 mg/kg in samples from different areas and from different parts of the lobster (higher levels in body meat than in claw or tail meat). USA data showed median levels ranging from 0.07 to 0.44 mg/kg in lobsters. Data from the United Kingdom and the USA on various kinds of shrimp show median levels to lie in the range from below 0.01 to 0.30 mg/kg. Irish, Japanese, and Swiss data on fresh crustacea show median levels in the range of 0.01 to 0.10 mg/kg.

Molluscs, etc

Data from the USA on abalone show median levels from 0.16 to 2.43 mg/kg in products from different areas. United Kingdom data on fresh whelks show median levels of 0.7 and 1.6 mg/kg for 1974 and 1975, respectively and data on periwinkles show levels below 0.2 mg/kg. Data on oysters submitted by Ireland, New Zealand, the United Kingdom, and the USA show median levels from 0.16 to 1.17 mg/kg. Data on mussels were supplied by Ireland, Japan, Switzerland, and the United Kingdom. They show most median levels to be between 0.07 and 0.4 mg/kg. United Kingdom and USA data on scallops show median levels ranging from 0.12 to 5.6 mg/kg for samples from different parts of each country. Data from the United Kingdom on cockles show all median levels to be below 0.2 mg/kg. United Kingdom and USA data on various types of clam show median levels in the range of 0.04 to 0.27 mg/kg.

Data on cuttlefish from the USA show median levels of about 0.1 mg/kg, while data from the Netherlands on the imported commodity show a median level of 0.62 mg/kg. Data from the USA on octupus and squid show median levels from 0.15 to 0.74 mg/kg.

3.2.3.2 Status of, and trends in the levels of cadmium in food

The data submitted do not show any clear time trends in the levels of cadmium in cereals or cereal flours. The Japanese data on mixed grain and the Canadian data on cereal flour suggest, if anything, a slight decrease in levels in recent years. Data from the Federal Republic of Germany show considerably lower cadmium levels in rye grain than in wheat.

Data on potatoes suggest that there has been little change in cadmium levels during the period studied. For 1975-77 the median levels reported from all countries were in the range of 20-45 μg/kg.

Data on kidney do not show any clear time trends in cadmium levels. Cadmium accumulates in the kidney with increasing age and this is consistent with the finding of higher levels in cattle kidney than in veal kidney. Of the domestic animals studied, sheep have the lowest kidney levels of cadmium. The levels in horse kidney are very much higher than those in kidney from other animals and in some countries horse kidney may not be sold for human consumption for this reason.

In most cases it is not possible to draw any conclusions from the data on crustacea and molluscs with regard to possible time trends in cadmium levels. Most of the data are representative of only part of the country concerned. High cadmium levels have been found in the brown meat of crabs.

3.2.3.3 Assessment of monitoring data

Cadmium is being discharged into the environment from a wide variety of sources, including the mining and metal industries, from the combustion of fuel and from the increasing use of municipal sewage sludge on agricultural land. Furthermore, phosphate fertilisers are nearly always contaminated with cadmium. In view of cadmium´s toxicological properties, it is important to try to prevent further increases in the levels of cadmium in staple foodstuffs.

3.3 MYCOTOXINS

3.3.1 Analytical methods

Most laboratories determined aflatoxins by methods based on thin layer chromatography or, to a lesser extent, higher performance liquid chromatography, both preceded by organic solvent extraction.

3.3.2 Aflatoxins

Aflatoxins are a group of toxic substances produced by the growth of Aspergillus flavus and certain other moulds. There is considerable evidence that aflatoxins are carcinogenic in a wide range of animals, when given orally. There is also epidemiological evidence that ingestion of aflatoxins increases the risk for primary liver cancer in man (4).

3.3.2.1 Summary of monitoring data

Maize, maize flour, etc

Data were supplied by Canada, Guatemala, Kenya, Mexico, the United Kingdom, and the USA. With the exception of data from samples representative of only part of Kenya, all levels were below the limit of detection (in most cases below 5 µg/kg).

Nuts and nut products

Data were provided by Guatemala, Japan, the Netherlands, Switzerland, the United Kingdom, and the USA. Almost all the median levels reported were below 5 µg/kg and usually below the limit of detection.

The USA submitted extensive data on groundnuts and groundnut butter. Except for groundnuts in 1974 (median level 5 µg/kg, 90th percentile 18 µg/kg) all the levels reported were below 4 µg/kg (the limit of detection).

Cow's milk

Data were submitted by Austria, Brazil, Kenya, the United Kingdom, and the USA on whole fluid or dried cow's milk. Kenya and the United Kingdom reported levels below the limit of detection (0.03 or 10 µg/kg). The USA reported a median level of 0.1 µg/kg in whole fluid cow's milk from part of the country and levels below the limit of detection (0.02 or 0.1 µg/kg) in domestic dairy produce and imported cheese.

3.3.2.2 Status of, and trends in levels of aflatoxin in food

The data submitted show, in general, very low aflatoxin levels, in most cases below the limit of detection. No time trends in aflatoxin levels in the foods studied can be seen from the data collected.

Although the present data show that the aflatoxin levels in the foods examined are generally low, it should be borne in mind that higher levels may be found locally, when conditions (high humidity and temperature) during harvesting and storage favour the growth of the moulds producing aflatoxins.

3.3.2.3 Assessment of monitoring data

There is considerable evidence that aflatoxins are carcinogenic in a wide range of animals, when given orally. There is also epidemiological evidence that ingestion of aflatoxins increases the risk of primary liver cancer in man (4). In view of this, it is important that every effort be made to reduce the contamination of food with aflatoxins and to prevent the ingestion of food that is contaminated with aflatoxins.

4. Summary and Assessment of Data Received on Dietary Levels and Intakes of Contaminants

4.1 BACKGROUND

Data were requested for contaminants in the total diet for Stages III and IV. The Expert Consultation in 1977[a] provided the following guidelines for the collection of total dietary intakes data:

"48. The consultation was aware that the 'total dietary intake' or 'assessment of dietary intake' has been calculated or determined in different ways by various countries. In some countries market basket surveys or total diet studies were carried out, in which foods ready for consumption were analyzed for contaminants. In other countries, the staple foods

---

a) Report of the Consultation on the Joint FAO/WHO Food and Animal Feed Contamination Monitoring Programme. Phase II. Geneva, 1977. (WHO-FCM/77.9, FAO/ESN: MON/77.9.)

were analyzed for the contaminants and, based upon the amounts of such foods consumed, an assessment of the amount of the contaminant being ingested was calculated. (See paragraph 66.) In reporting on the total dietary intake, Collaborating Centres would have to give details on how this intake was arrived at."

"66. Regarding the calculation of the intake of a contaminant via food (see also paragraph 48), it was agreed that the Guidelines should recommend the method based on the analysis of the individual staple foods and information on food consumption, rather than the market-basket-type of total diet study which required considerably larger resources and detailed planning."

As noted in the Report of the Second Session of the Technical Advisory Committee[b] this recommendation was made especially for developing countries.

4.2 METHODS USED TO ESTIMATE CONTAMINANT INTAKES

Data on contaminants in total diets were reported from Collaborating Centres in Austria, Canada, Guatemala, Hungary, Japan, New Zealand, the United Kingdom, and the USA. Comments received from the Collaborating Centres indicated that the character of the total diets and their preparation for analyses varied widely. (Table II.) Some of the information lacking in this Report may be available at the Collaborating Centres.

4.2.1 Austria

The data reported from Austria were based on the food eaten by 5 adult males and 5 adult females over a seven-day period in Vienna and the environs. The prepared foods eaten in the home, at work, or in restaurants, each day, by each individual were divided into the following categories: breakfast, soups, lunch, desserts, evening meal, fruits, between-meal foods, and beverages. All beverages including milk, coffee, tea, fruit juices, alcoholic beverages and drinking water were included. The average weight of the monthly diet was 49.35 kg (i.e., 1.65 kg/day). Data were submitted on the median and 90th percentile intakes per person of the contaminant concerned.

4.2.2 Canada

Results were submitted in terms of µg/person/day, expressed as medians and noted that "All of the Canadian total diet studies have been based on analyses of twelve composite food groups and calculation of the exposure of the average Canadian to each chemical from these results. For some of the reported studies, food consumption was based on food disappearance data which indicated a consumption of 1 784 g of raw food per day. The later years of

---

a) Report of the Second Session of the Technical Advisory Committee. Geneva, 1981. (FAO-ESN/MON/TAC-2/81/5; WHO-EFP/81.15.)

the study used food recall studies to determine daily food intake. These indicated a daily food consumption of 1 034 g of cooked, ready to eat foods". The Canadian total diet does not include drinking water. Information was not given concerning the possible inclusion of other beverages, such as coffee, tea, and alcoholic beverages.

4.2.3 Guatemala

Data were reported for median levels of contaminant per kilogram food for meals prepared according to local custom, followed by homogenization. Results were reported for two different population groups; those in a lower income group from an urban area, and those in a lower income group from a rural area. It is not known which beverages, including drinking water, were included in the meals analysed. Information on the average weight of the daily diet was not submitted.

4.2.4 Hungary

Data were submitted in terms of median and 90th percentile levels of contaminants in fully prepared foods collected at institutions such as boarding schools, old peoples´ homes, childrens´ homes, nursery schools, medical homes for children, and hostels for boys and for students. Beverages, except for soft drinks and alcoholic beverages, were included. In addition, data were obtained on a nationwide basis for meals from public catering places. Information concerning the average daily weights of the meals was not submitted.

4.2.5 Japan

Data were submitted for the median, mean and maximum daily intakes (μg/person) obtained by the market basket method. The level of contaminants in the diet may then be calculated from the amount of daily diet. Their total diet consists of 90 food items, including drinking water, alcoholic and other beverages, divided into 14 groups. This diet is based on food consumed by the average person and amounts to about 1.4 kg/day. The foods were cooked where appropriate.

4.2.6 New Zealand

Total diet in New Zealand amounts to about 3.3 kg/day, representing the diet of an active young man, whose energy intake is about 1.3 times that of a moderately active young man and twice that of a moderately active young woman (5). The different food commodities are prepared in the kitchen, but not cooked, and are then composited into 8 groups. Beverages, including beer, are included in this total diet. It is not known whether water was one of the commodities collected. New Zealand submitted medians and 90th percentile data in terms of μg contaminant/kg of each of the food groups. Since the daily consumption of each food group has been published (6), it was possible to calculate the daily dietary intake of the contaminant from each group, for inclusion in the Tables. In this case, zero intake was ascribed to a food group in which the contaminant was not detected, since New Zealand treated "Not detected" findings as zero. In order to obtain an estimated median total daily intake of the contaminants concerned for inclusion in the Tables, the median intakes of a particular contaminant in all 8 food groups were added together. Even though the median is more properly obtained from the ranking of the total intakes of each of the total diets (16 in this case), the approach employed was the only one that could be used to estimate the median daily intakes with the data at hand.

4.2.7 United Kingdom

Each of 78 food items in the total diet were prepared as for eating, including cooking, and combined into 9 composite food groups for analysis. In 1975, other beverages besides milk were added to the total diet. Alcoholic beverages and drinking water were not included. The average weight of the daily total diet was 1.5 kg. The diet was based on data developed on household purchases of food. It therefore represents the food eaten in the home by the average individual. The UK submitted data on median levels of the contaminant concerned in each of the composites and also in the total diet. Only the contaminant levels in the total diet are reported in the Tables.

4.2.8 United States of America

Food items were collected as a "market basket" consisting of the two-week diet of a typical 15-20-year-old male in the section of the country from which it was collected. The US Department of Agriculture diet guides, developed in 1965, were used as the basis of the diet. The weight of the daily diet was about 2.9 kg. The 117 items that comprise a market-basket were prepared as for eating, including cooking where appropriate, and separated into 12 food groups. Beverages other than milk, such as coffee, tea, soft drinks, and drinking water were included in the total diet, with the exception of alcoholic beverages. The USA submitted data on mean daily intake (µg/person). Beginning with 1979, median as well as mean intakes were also reported.

4.3 SUMMARY AND ASSESSMENT OF DATA

The data received on organochlorine contaminants, lead, cadmium, and aflatoxins, are summarized in Tables III-X. In the case of Guatemala and Hungary, it was assumed that the average daily dietary consumption was 1.5 kg/day, in order to estimate the µg/person/day intake of the contaminant concerned.

The acceptable daily intakes (ADI) for certain pesticides are given in Appendix IV for use in evaluating these results. In comparing daily dietary intake data in µg/person/day with the ADI (mg/kg body weight) the average weight of a person was assumed to be 70 kg.

4.3.1 DDT Complex

The data obtained from Canada, Guatemala, Hungary, Japan, New Zealand, and the USA on residues of the DDT complex in the diet are given in Table III. Assuming a body weight of 70 kg it can be seen that the median daily dietary intakes are well below the ADI in all cases. The estimated intakes from Guatemala (based on two samples) are higher than those obtained from the total diet studies in other countries. The estimated median dietary intake in New Zealand is also somewhat higher than in other countries. In Canada, there was a definite downtrend in the median dietary intake from 1971 to 1977, perhaps reflecting the decreased use of DDT in that country. Both the median and mean intakes were reported from Japan and the USA for 1979. In both cases, especially the USA, the mean intakes were higher than the median intakes. Computations based on 90th percentile values given by Hungary and New Zealand show that again daily dietary intakes of DDT are below the ADI of 0.005 mg/kg body weight.

4.3.2 Total HCH Isomers and Lindane

The data submitted from Canada, Guatemala, Hungary, Japan, and the USA on total HCH isomers in the diet are given in Table IV. No ADI has been proposed by FAO/WHO for total HCH isomers. New Zealand reported data only on lindane (the gamma-HCH isomer). The medians as well as 90th percentile levels are in most cases below the limit of detection.

4.3.3 Aldrin/Dieldrin

Comparison of the aldrin/dieldrin data (Table V) from Canada, Guatemala, New Zealand, Japan, and the USA with the ADI for the sum of these pesticides (Appendix IV) indicates that the 1979 median daily dietary intakes of these products were about 10 % of the ADI in Japan, 15 % in the USA, and 40 % in Guatemala (only in meals prepared in the urban area). This is the only instance in which a significant difference was reported for the level of a contaminant in the urban and rural diets in this country. Dietary intakes of aldrin/dieldrin in Canada and the USA had been around 30-40 % of the ADI in earlier years, but have since declined. There was no real difference between the median and the mean dietary intakes reported by either Japan or the USA for 1979.

4.3.4 Heptachlor and Heptachlor Epoxide

The results obtained on levels and dietary intakes of heptachlor and heptachlor epoxide in Canada, Guatemala, Japan, and the USA are summarized in Table VI. In every case, the intakes are very much below the ADI. No significant trend is apparent in countries reporting data for a series of years (Canada and the USA). The mean and median intakes reported by Japan and the USA for 1979 are about the same for each country.

4.3.5 Hexachlorobenzene

The data in Table VII indicate that the median and 90th percentile intakes for hexachlorobenzene (HCB) are in most cases well below 10 µg/person/day in the diets studied in Canada, Hungary, Japan, and the USA. The ADI for HCB was 42 µg/person/day, but it has been withdrawn. The data indicated a downtrend in the intake of this pesticide in Canada from 1973 to 1977. The µg/person/day intakes reported for the Canadian and the USA diets in 1977 were about the same. Again, there was no real difference between the median and mean daily dietary intakes reported by either Japan or the USA for 1979.

4.3.6 Polychlorinated Biphenyls

The data for polychlorinated biphenyls (PCBs) in the diets of Canada, Guatemala, Japan, the United Kingdom, and the USA are summarized in Table VIII. Results indicate a dietary intake below 15 µg/person/day. No ADI has been proposed for the PCBs. There is no discernible trend in the reported dietary intakes from 1972 to 1979 in the USA. However, there appears to be a variation, depending on whether some contamination incidents occurred or not. This assumption is consistent with the fact that the mean intake is appreciably higher than the median intake in 1979, the only year in which both mean and median intakes were reported by the USA. A few unusually high findings may have an appreciable effect on the mean level, but little on the median.

4.3.7 Lead

The data reported from Austria, Canada, Guatemala, Hungary, Japan, New Zealand, the United Kingdom, and the USA on dietary levels and intakes of lead are given in Table IX. The median dietary intakes vary up to about 250 µg/person/day for Guatemala (1979) and New Zealand (1975) compared with a provisional tolerable intake of 430 µg/person/day. The high intake reported in New Zealand in partially due to the greater weight of the daily diet used for the New Zealand studies. It is of interest that about 40 % of the lead intake from this diet was supplied from the canned foods composite. In Japan, the median intake for 1979 was significantly lower than the mean intake. In the USA, the difference was not so great.

4.3.8 Cadmium

Inspection of the data on cadmium (Table X) shows that the estimated median dietary intakes from Guatemala are slightly above a provisional tolerable intake of 60-70 µg/person/day. Canada, Japan, the United Kingdom, and the USA report values that approximate this tolerable daily intake, while Austria, Hungary, and New Zealand report lower median intakes. In both the USA and Japan, the median intakes are slightly lower than the means.

4.3.9 Aflatoxins

Only Guatemala submitted data on aflatoxins in the total diet. Aflatoxin residues were not detected in the samples examined (detection limit, 4 µg/kg).

4.4 HUMAN MILK DATA

Estimates of total dietary intake of contaminants for breast-fed infants may be obtained from human milk data. For the first three months of life, an infant consumes on the average 0.12 kg per day of human milk/kg body weight, the volume consumed per unit weight decreasing with increasing age (DeMaeyer, personal communication, 1981). By multiplying the concentration of a given contaminant (in mg/kg) by 0.12 kg/day/kg body weight the approximate daily intake of the contaminant may be estimated and this in turn may be compared to the ADI established for certain pesticides. Human milk data were requested on an "as is" basis. The data from the Federal Republic of Germany were submitted on a fat basis and these were multiplied by 0.036 in order to obtain an estimate of the levels on "as is" basis.

4.4.1 DDT Complex

Approximate median dietary intakes for DDT have been computed and are presented in Table XI. It can be seen that the median levels of DDT in breast milk are such that the intake by the breast fed infant may exceed the ADI in some cases. 90th percentile values given are often two times higher than the median values indicating that in 10 % of the cases, the ADI is often exceeded.

4.4.2 Other organochlorine pesticides

Data submitted on 90th percentile and median levels of gamma-HCH (lindane) and heptachlor and its epoxide in human milk indicate that in most cases the estimated intakes are well below the respective ADIs (Tables XII and XIII).

Data from Japan and parts of Switzerland on median levels of aldrin and dieldrin in human milk indicate that the ADI of 0.0001 mg/kg body weight is exceeded in all cases (Table XIV). Guatemala reports low median levels of aldrin and dieldrin in human milk (less than 1 µg/kg, the limit of detection). The Austrian data (converted to "as is" basis) also show low levels.

Median levels of HCB, higher than 5 µg/kg, have been reported by Austria and the Federal Republic of Germany (converted to "as is" basis by multiplying by 0.036), Hungary, the Netherlands, and Switzerland. However, many of the samples were representative of only parts of the country. Assuming again a human milk daily intake of 0.12 kg/kg body weight, a concentration of more than 5 µg/kg may result in an intake exceeding the conditional ADI for HCB, now withdrawn, of 0.0006 mg/kg body weight.

4.4.3 Assessment of monitoring data

The reported levels of certain chlorinated compounds in human milk may result in an intake by the breast-fed infant that exceeds the ADI in some cases.

However, the ADI is developed on the basis of lifetime exposure, while intake of contaminants from human milk is usually limited to a few months of a lifetime. Moreover, there is no evidence so far that this has any deleterious effects on the health of the infant and consequently, because of the well recognized advantages of breast feeding, this practice should not be discouraged.

REFERENCES

1. Environmental Health Criteria 9: DDT and its derivatives, Geneva, World Health Organization, 1979.

2. Environmental Health Criteria 2: Polychlorinated biphenyls and terphenyls, Geneva, World Health Organization, 1976.

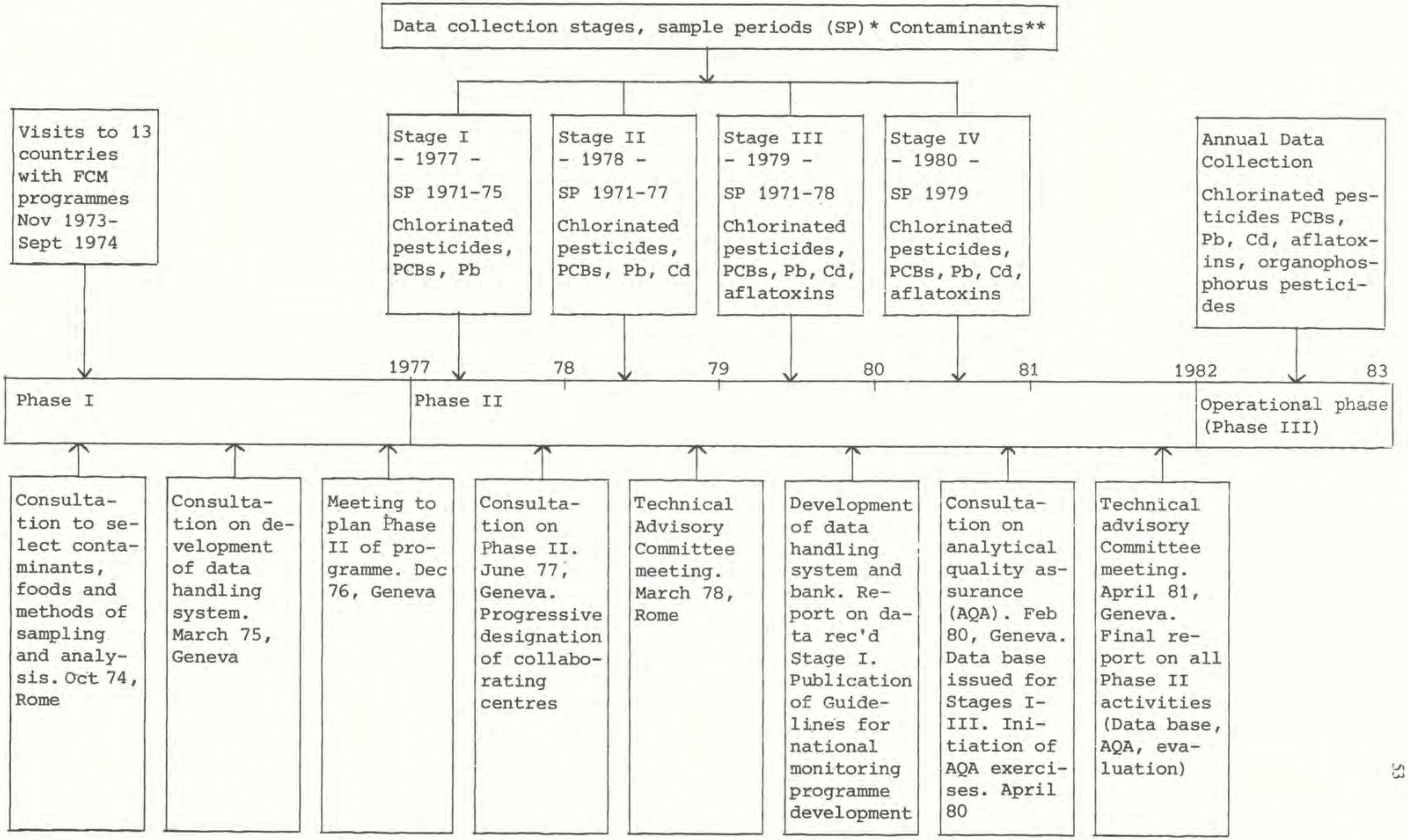
3. Environmental Health Criteria 3: Lead, Geneva, World Health Organization, 1977.

4. Environmental Health Criteria 11: Mycotoxins, Geneva, World Health Organization, 1979.

5. Passmore, R., Nicol, B.M., Narayana Rao, M., Beaton, G.H. and DeMaeyer, E.M. Handbook on Human Nutritional Requirements, Geneva, WHO (World Health Organization Monograph Series No 61, 1974).

6. Dick, G.L., Hughes, J.T., Mitchell, J.W. and Davidson F. Survey of trace elements and pesticide residues in the New Zealand diet. N. Zealand Journal of Sci. 21: 57-69 (1978).

Food and Animal Feed Contamination Monitoring (FCM) Programme



*Sample Period (SP) refers to time of sample collection

**For details on contaminants and foods analyzed see Appendix III

Appendix II

Collaborating Centres for Joint FAO/WHO Food and Animal Feed Contamination Monitoring Programme

Country	Institute	Responsible Officer	Date Designated	Data submitted for Stages: I	II	III	IV
Australia	Food Administration Australia Commonwealth Department of Health P O Box 100 WODEN, A C T 2606	Mr M P Jackson	Jan 1981				
Austria	Ministry of Health and Environmental Protection A-1010 VIENNA	Dr J Ettl	May 1977			III	IV
Brazil	Instituto Adolfo Lutz Avenida Dr Arnaldo 355 Caixa Postal 7027 SAO PAULO	Dr W H Lara	July 1978		II	III	IV
Canada	Food Directorate Health Protection Branch Department of National Health and Welfare Tunney's Pasture OTTAWA K1A 012	Dr H Conacher	May 1977	I	II	III	IV
China	Institute of Health Chinese Academy of Medical Sciences 29 Nan wei Road BEIJING	Dr Chen Chunming	Jan 1981				

Denmark	National Food Institute 19 Morkhoj Bygade DK-2860 SOBORG	Dr N Borre	May 1977	I	II	III	IV
Egypt	Sanitary Chemistry Laboratories Central Laboratories General Administration Ministry of Health Falaki 18 Sheikh Rihan Street CAIRO	Dr H M Hassanein	Nov 1977		II	III	IV
Germany, Fed Rep of	Centre for Surveillance and Evaluation of Health Hazards by Environmental Chemicals (ZEBS) Bundesgesundheitsamt Theilallee 88/92 1000 BERLIN 33 (West)	Dr P Weigert	May 1977	I	II	III	IV
Guatemala	Unified Food and Drug Control Laboratory (LUCAM) INCAP P O Box 1188 GUATEMALA CITY	Ing (Mrs) Marit de Campos	Dec 1977	I	II	III	IV
Hungary	Department of Toxicological Chemistry Institute of Nutrition Gyali ut 3a 1097 BUDAPEST	Dr V Cieleszky	May 1977	I	II	III	IV
Ireland	Department of Agriculture Agriculture House DUBLIN 2	Dr T O'Toole	Apr 1977	I	II	III	IV

Japan	Food Division National Institute of Hygienic Sciences 1-18-1 Kamiyoga Setagaya-ku TOKYO 158	Dr M Uchiyama	Aug 1977	I	II	III	IV
Kenya	National Public Health Laboratory Ministry of Health P O Box 20750 NAIROBI	Dr J N Kaviti	May 1978			III	IV
Mexico	Subsecretaria de Mejoramiento del Ambiante Secretaria de Salubridad y Asistencia MEXICO D F	Dr G Diaz Mejia	Jan 1979			III	
Netherlands	National Institute of Public Health Antonie van Leeuwenhoeklaan 9 Postbus 1 BILTHOVEN	Dr P A Greve	May 1977	I	II	III	IV
New Zealand	Food Section Food and Nutrition Branch Division of Public Health Department of Health P O Box 5013 WELLINGTON	Mr J Fraser	Mar 1978		II	III	IV
Poland	Department of Food Research National Institute of Hygiene 24 Chocimska Street 00-791 WARSAW	Prof M Nikonorow	May 1977	I	II		

Qatar	Regional Centre Food Contamination Monitoring P O Box 7083 DOHA	Dr A R Kotb	Mar 1979				IV
Sweden	Toxicology Laboratory National Food Administration Box 622 S-751 26 UPPSALA	Dr S A Slorach	May 1977	I	II		IV
Switzerland	Federal Office of Public Health Food Control Division Postfach 2644 3001 BERN	Dr G Gerber	May 1977	I	II	III	IV
United Kingdom	Food Science Division Ministry of Agriculture Fisheries and Food Great Westminster House Horseferry Road LONDON SW1P, 2AE	Dr P J Bunyan	June 1977	I	II	III	
USA	Bureau of Foods Public Health Service Food and Drug Administration Department of Health and Human Services 200 C St S W WASHINGTON, D C 20204	Dr C F Jelinek	May 1977	I	II	III	IV
USSR	Institute of Nutrition Academy of Medical Sciences Ust'inskiu pr 2/14 MOSCOW 109240	Prof V A Shaternikov	Oct 1979				

APPENDIX III

DATA REQUESTED FROM JOINT FAO/WHO FOOD AND ANIMAL FEED CONTAMINATION MONITORING COLLABORATING CENTRES AT VARIOUS STAGES OF PHASE II OF THE PROGRAMME

Stage	Contaminants	Foods	Sample Period
I	DDT-complex, total HCH isomers, sum heptachlor + heptachlor epoxide, sum aldrin + dieldrin, HCB and PCBs	Whole fluid cow's milk, whole dried cow's milk, butter and human milk*	1971 - 1975
	Lead	Canned fruits, fruit juices including concentrates, vegetables and milk (all in cans with lead-soldered seams)	1971 - 1975
II	DDT-complex, total HCH isomers, sum heptachlor + heptachlor epoxide, sum aldrin + dieldrin, HCB and PCBs	Whole fluid cow's milk, whole dried cow's milk, butter and human milk*	1976 - 1977
		Edible fats and oils, and finish	1971 - 1977
	Lead	Canned fruits, fruit juices including concentrates, mixed juices for infants, vegetables, and milk (all in cans with lead-soldered seams)	1976 - 1977
		Cereal flours, potatoes and other vegetables of major importance, molluscs, crustaceans, and kidney	1971 - 1977
	Cadmium	Molluscs, crustaceans, grains, cereal flours, potatoes, and kidney	1971 - 1977

* Data requested on all organochlorine compounds studied

III	DDT-complex, total HCH isomers, sum heptachlor + heptachlor epoxide, sum aldrin + dieldrin, HCB, and PCBs	Whole fluid cow's milk, whole dried cow's milk, butter, human milk,* edible fats and oils, and finfish	1978
		Cereals, eggs, fruits, and vegetables	1971 - 1978
		Total diet	1971 - 1978
	Lead	Canned fruit, fruit juice including concentrates, mixed juice for infants, vegetables, and milk (all in cans with lead-soldered seams)	1978
		cereal flours, potatoes and other vegetables of major importance, molluscs, crustaceans, and kidney	1978
		Total diet	1971 - 1978
	Cadmium	Molluscs, crustaceans, grains, cereal flours, potatoes and kidney	1978
		Total diet	1971 - 1978
	Aflatoxins	Peanuts, tree nuts, maize, and milk	1971 - 1978
		Total diet	1971 - 1978

* Data requested on all organochlorine compounds studied.

APPENDIX III (cont.)

IV	DDT-complex, total HCH isomers, sum heptachlor + heptachlor epoxide, sum aldrin + dieldrin, HCB, and PCBs	Whole fluid cow's milk, whole dried cow's milk, butter, human milk,* edible fats and oils, and finfish	1979
		Cereals, eggs, fruits, and vegetables	1979
		Total diet	1979
	Lead	Canned fruits, fruit juices including concentrates, mixed juices for infants, vegetables, and milk (all in cans with lead-soldered seams)	1979
		Cereal flours, potatoes and other vegetables of major importance, molluscs, crustaceans, and kidney	1979
		Total diet	1979
	Cadmium	Molluscs, crustaceans, grains, cereal flours, potatoes and kidney	1979
		Total diet	1979
	Aflatoxins	Peanuts, tree nuts, maize, and milk	1979
		Total diet	1979

* Data requested on all organochlorine compounds studied.

ADIs and residue limits for certain chlorinated pesticides as of October 1981[a]

Pesticides	Recommended Maximum Acceptable Daily Intake (mg/kg body weight)	Commodity	Residue Limits, mg/kg: Maximum Residue Limit (MRL) or TMRL[b]	Residue Limits, mg/kg: Extraneous Residue Limit (ERL)	Remarks
Aldrin/dieldrin	0.0001	Potatoes	0.2		Limits are for aldrin or dieldrin separately or for their sum expressed as dieldrin if both are present. Extraneous residue limit for shell-free eggs is equivalent to 0.25 mg/kg in egg yolk
		Carrots, lettuce, fat of meat		0.2	
		Asparagus, aubergines, broccoli, brussels sprouts, cabbage, cauliflower, cucumbers, horse radish, onions, parsnips, peppers, pimentos, radishes, radish tops	0.1		
		Eggs (shell-free)		0.1	
		Milk and milk products (fat basis)		0.15	
		Fruit	0.05		
		Rice (in husk)	0.02		
		Raw cereals (other than rice)		0.02	
DDT	0.005 (see remarks)	Fruit (except grapes)	1		ADI is "conditional". MRL on fish was withdrawn at the 1969 Meeting. Limits apply to p,p'-DDT, o,p'-DDT, p,p'-DDE and p,p'-TDE (DDD) singly or in combination. MRLs subject to regular review
		Grapes	2		
		Fat of meat and poultry	7		
		Nuts (shelled)	1		
		Milk and milk products (fat basis)		1.25	
		Eggs (shell-free)		0.5	
		Vegetables	1		
		Cereals grains		0.1	

[a]Based on figures contained in "Index & Summary 1965-1978" Pesticide Residues in Food. FAO Plant Production and Protection Paper 11, Rome 1978.

[b]TMRL - Temporary limits

Pesticides	Recommended Maximum Acceptable Daily Intake (mg/kg body weight)	Commodity	Residue Limits, mg/kg: Maximum Residue Limit (MRL) or TMRL	Residue Limits, mg/kg: Extraneous Residue Limit (ERL)	Remarks
Heptachlor	0.0005	Pineapple (edible portions)	0.01		Residues of heptachlor and its epoxide to be determined separately and the sum to be expressed as heptachlor. Certain of the extraneous residue limits may include residues resulting from applications to soil or seed.
		Crude soyabean oil		0.5	
		Carrots, fat of meat and poultry		0.2	
		Milk and milk products (fat basis)		0.15	
		Eggs (shell-free), sugarbeet, vegetables (except carrots, soybeans, tomatoes)		0.05	
		Raw cereals, tomatoes, cottonseed, soybeans, edible soybean oil		0.02	
		Citrus fruit		0.01	
Hexachlorobenzene	0.0006 (withdrawn)	Eggs (shell-free), fat of meat of cattle, goats, pigs, poultry and sheep		1*	
		Milk and milk products (fat basis)		0.5*	
		Raw cereals		0.05*	
		Flour and similar milled cereal products		0.01*	

*Guideline levels are included to assist administering authorities, even though ADIs have not been established for the individual products, or temporary ADIs established at an earlier date have been withdrawn. The levels recommended are those that need not be exceeded if good practices are followed.

Pesticides	Recommended Maximum Acceptable Daily Intake (mg/kg) body weight	Commodity	Residue Limits, mg/kg Maximum Residue Limit (MRL) or TMRL	Residue Limits, mg/kg Extraneous Residue Limit (ERL)	Remarks
Lindane	0.01	Cranberries, strawberries	3		
		Endive, lettuce, tomatoes, fat of meat of cattle, pigs and sheep, spinach	2		
		Beans (dried), cocoa beans, kohl-rabi, radish	1		
		Apples, brussels sprouts, cabbage, cauliflower, cherries, grapes, pears, plums, raw cereals, red currants, rice (in husk), savoy cabbage	0.5		
		Peas, sugarbeet (roots), sugarbeet (leaves)	0.1		
		Potatoes, rapeseed	0.05		
		Poultry (fat basis)		0.7	
		Carrots, eggs (shell-free), milk and milk products (fat basis)		0.1	
		Cocoa butter	1		

Table I Reported median lead levels in certain fresh and canned fruits and vegetables

Food	Country	Year	Median lead level, mg/kg	
			Fresh	Canned
Tomatoes	Canada	1975	0.04 (n=42)	0.31* (n=13)
	USA	1977	<0.05 (n=60)	
		1978	<0.02 (n=61)	0.26 (n=96)
Green beans	USA	1977	<0.05 (n=42)	0.13 (n=116)
Oranges	Sweden	1975	0.011 (n=14)	
	Switzerland	1973		0.47* (n=11)
	United Kingdom	1975		0.30* (n=6)
		1975		0.82* (n=20)
Cherries	Sweden	1975	0.018 (n=14)	
	United Kingdom	1973		0.60* (n=17)
Plums	Sweden	1975	0.016 (n=15)	
	USA	1974		0.16* (n=29)
	United Kingdom	1974		0.66* (n=12)
		1974		0.35* (n=24)
		1976		0.26* (n=435)

n = number of samples

* = mean

Table II Total diet studies, reporting countries

	Austria	Canada	Guatemala	Hungary	Japan	New Zealand	United Kingdom	USA
Weight (kg) per day	1.65	1.03	*	*	1.4	3.31	1.5	2.9
Population group	Adult	Avg. person	Rural, urban, lower income	Institu-tional; Public catering	Avg. male	Active young man	Avg. person	Teenage male
Food items collected	Daily personal consump-tion	120	Complete meals	Complete meals	90	*	78	117
Alcoholic beverages	Yes	*	*	No	Yes	Yes	No	No
Drinking water	Yes	No	*	*	Yes	*	No	Yes
No of composites	8	11	*	*	14	8	9	12
Prep before analysis	Home, workplace, restau-rant	Kitchen prep., incl. cooking	According to local custom	Institu-tional; Public catering	Kitchen prep., incl. cooking	Kitchen prep., no cooking	Kitchen prep., incl. cooking	Kitchen prep., incl. cooking

* Information on this item not submitted by Collaborating Centre

Table III Summary of data, DDT complex in total diet

Country	Year	Food Origin	Part of Country	Number of Samples	Level. µg/kg, Diet Median	Level. µg/kg, Diet 90th perc.	Intake, µg/person/day Median	Intake, µg/person/day Mean	Intake, µg/person/day 90th perc.
Canada	1971	Both	Part	4			11.6		-
	1972	Both	Part	4			4.8		-
	1973	Both	Part	4			4.1		-
	1974	Both	Part	20			1.7		-
	1977	Both	Whole	20			1.6		-
Guatemala	1979	Domestic	Part	1	29		43.5[a]		
	1979	Domestic	Part	1	40		60.0[a]		
Hungary	1978	Domestic	Part	10	5.0	8.0	7.5[a]		12.0[a]
	1978	Domestic	Part	10	7.0	9.0	10.5[a]		13.5[a]
	1978	Domestic	Whole	20	5.0	8.0	7.5[a]		12.0[a]
	1979	Domestic	Part	26	3.0	5.0	4.5[a]		7.5[a]
	1979	Domestic	Whole	20	14.0	24.0	21.0[a]		36.0[a]
	1979	Domestic	Part	26	6.0	10.0	9.0[a]		15.0[a]
	1979	Domestic	Whole	40	4.4	14.0	6.6[a]		21.0[a]
	1979	Domestic	Part	16	8.7	21.0	13.1[a]		31.5[a]
	1979	Domestic	Part	10	1.0	3.0	1.5[a]		4.5[a]
	1979	Domestic	Part	20	4.8	7.5	7.2[a]		11.2[a]
Japan	1979	Both	Whole	10			3.3	3.9	8.0*
New Zealand	1975								
	Grain & cereal products	Both	Whole	16	4.0	7.0	1.3		2.3
	Meat, fish, eggs	Domestic	Whole	16	42.0	123.0	13.5		39.5
	Dairy products	Domestic	Whole	16	18.0	40.0	9.4		20.8
	Vegetables	Domestic	Whole	16	<5.0	<5.0	0.0		0.0
	Fruit	Both	Whole	16	<5.0	43.0	0.0		8.2
	Confections, beverages	Both	Whole	16	<5.0	<5.0	0.0		0.0

Table III (cont.)

Country	Year	Food Origin	Part of Country	Number of Samples	Level, µg/kg, Diet		Intake, µg/person/day		
					Median	90th perc.	Median	Mean	90th perc.
New Zealand (cont.)	Imported fruit, etc	Imported	Whole	16	<5.0	25.0	0.0		1.5
	Canned fruit, etc	Both	Whole	16	<5.0	16.0	0.0		7.4
	Total Diet, calcd.	Both	Whole				24.2[b]		79.7[b]
USA	1972	Both	Whole	35				5.8	-
	1973	Both	Whole	30				7.6	-
	1974	Both	Whole	30				6.1	-
	1975	Both	Whole	20				5.8	-
	1976	Both	Whole	20				4.3	-
	1977	Both	Whole	25				3.2	-
	1978	Both	Whole	20				4.9	-
	1979	Both	Whole	20	1.0	3.9	2.8	6.5	10.9

[a] Calculated, based on assumed daily total dietary consumption of 1.5 kg

[b] Summation of intakes from each of above food groups

* Maximum

Table IV Summary of data, total HCH isomers in total diet

Country	Year	Food Origin	Part of Country	Number of Samples	Level, µg/kg, Diet		Intake, µg/person/day		
					Median	90th perc.	Median	Mean	90th perc.
Canada	1971	Both	Part	4			3.5		-
	1972	Both	Part	4			3.3		-
	1973	Both	Part	4			2.3		-
	1974	Both	Whole	20			0.9		-
	1977	Both	Whole	20			0.7		-
Guatemala	1979	Domestic	Part	1	<1.0		<1.5[a]		
	1979	Domestic	Part	1	<1.0		<1.5[a]		
Hungary	1978	Domestic	Part	10	10.0	13.0	15.0[a]		
	1978	Domestic	Whole	20	1.0	5.0	1.5[a]		
	1978	Domestic	Part	10	9.0	18.0	13.5[a]		
	1979	Domestic	Part	20	14.0	18.0	21.0[a]		
	1979	Domestic	Part	26	2.0	6.0	3.0[a]		
	1979	Domestic	Whole	40	<0.1	5.2	<1.5[a]		
	1979	Domestic	Part	16	1.4	5.0	2.1[a]		
	1979	Domestic	Part	10	0.6	1.6	0.9[a]		
	1979	Domestic	Part	20	0.7	1.3	1.1[a]		
Japan	1979	Both	Whole	10			2.2	2.3	3.7*
USA	1972	Both	Whole	35				0.3	-
	1973	Both	Whole	30				0.9	-
	1974	Both	Whole	30				1.7	-
	1975	Both	Whole	20				1.0	-
	1976	Both	Whole	20				1.1	-
	1977	Both	Whole	25				1.0	-
	1978	Both	Whole	20				0.8	-
	1979	Both	Whole	20	0.3	0.5	0.8	1.0	1.4

[a] Calculated, based on assumed daily total dietary consumption of 1.5 kg.

*Maximum

Table V Summary of data, aldrin and dieldrin in total diet

Country	Year	Food Origin	Part of Country	Number of Samples	Level, µg/kg Diet		Intake, µg/person/day		
					Median	90th perc.	Median	Mean	90th perc.
Canada	1971	Both	Part	4			2.3		-
	1972	Both	Part	4			1.5		-
	1973	Both	Part	4			1.8		-
	1974	Both	Whole	20			0.7		-
	1977	Both	Whole	20			0.1		-
Guatemala	1979	Domestic	Part	1	<1.0	-	<1.5[a]		-
	1979	Domestic	Part	1	2.0	-	3.0[a]		-
New Zealand[c]	1975								
	Grain & cereal products	Both	Whole	16	<5.0	<5.0	0.0		
	Meat, fish, eggs	Domestic	Whole	16	<5.0	7.0	0.0		
	Dairy products	Domestic	Whole	16	<5.0	9.0	0.0		
	Vegetables	Domestic	Whole	16	<5.0	<5.0	0.0		
	Fruit	Both	Whole	16	<5.0	<5.0	0.0		
	Confections, beverages	Both	Whole	16	<5.0	<5.0	0.0		
	Imported fruit, etc	Imported	Whole	16	<5.0	<5.0	0.0		
	Canned fruit, etc	Both	Whole	16	<5.0	<5.0	0.0		
	Total Diet, calcd.	Both	Whole	16			0.0[b]		
Japan	1979	Both	Whole	10			0.71	0.66	1.8*
USA	1972	Both	Whole	35				2.0	-
	1973	Both	Whole	30				2.8	-
	1974	Both	Whole	30				3.1	-
	1975	Both	Whole	30				2.6	-

Table V (cont.)

Country	Year	Food Origin	Part of Country	Number of Samples	Level, µg/kg Diet		Intake, µg/person/day		
					Median	90th perc.	Median	Mean	90th perc.
USA (cont.)	1976	Both	Whole	30				2.8	-
	1977	Both	Whole	25				1.6	-
	1978	Both	Whole	20				1.2	-
	1979	Both	Whole	20	0.4	0.5	1.0	1.1	1.5

[a] Calculated, based on assumed daily dietary consumption of 1.5 kg

[b] Summation of intakes from each of above food groups

[c] Levels reported for dieldrin only

*Maximum

Table VI Summary of data, heptachlor and heptachlor epoxide in total diet

Country	Year	Food Origin	Part of Country	Number of Samples	Level, µg/kg Diet		Intake, µg/person/day		
					Median	90th perc.	Median	Mean	90th perc.
Canada	1971	Both	Part	4			0.3		-
	1972	Both	Part	4			ND		-
	1973	Both	Part	4			0.3		-
	1974	Both	Whole	20			0.1		-
	1977	Both	Whole	20			0.05		-
Guatemala	1979	Domestic	Part	1	<1.0		<1.5[a]		
	1979	Domestic	Part	1	<1.0		<1.5[a]		
Japan	1979	Both	Whole	10			0.11	0.13	0.38*
USA	1972	Both	Whole	35				0.2	-
	1973	Both	Whole	30				0.4	-
	1974	Both	Whole	30				0.7	-
	1975	Both	Whole	20				0.5	-
	1976	Both	Whole	20				0.4	-
	1977	Both	Whole	25				0.5	-
	1978	Both	Whole	20				0.5	-
	1979	Both	Whole	20	0.1	0.4	0.3	0.4	1.0

[a] Calculated, based on assumed daily total dietary consumption of 1.5 kg

*Maximum

Table VII Summary of data, hexachlorobenzene in total diet

Country	Year	Food Origin	Part of Country	Number of Samples	Level, µg/kg Diet		Intake, µg/person/day		
					Median	90th perc.	Median	Mean	90th perc.
Canada	1973	Both	Part	4			5.1		-
	1974	Both	Whole	20			0.8		-
	1977	Both	Whole	20			0.05		-
Hungary	1978	Domestic	Part	10	2.0	2.0	3.0[a]		3.0[a]
	1978	Domestic	Part	10	2.0	4.0	3.0[a]		6.0[a]
	1979	Domestic	Part	20	4.0	6.0	6.0[a]		9.0[a]
	1979	Domestic	Part	16	<0.1	1.0	<0.15[a]		1.5[a]
	1979	Domestic	Part	20	<0.1	0.5	<0.15[a]		0.7[a]
Japan	1979	Domestic	Whole	10			0.17	0.35	0.96*
USA	1972	Both	Whole	35				0.03	-
	1973	Both	Whole	30				0.4	-
	1974	Both	Whole	30				0.1	-
	1975	Both	Whole	20				0.3	-
	1976	Both	Whole	20				0.1	-
	1977	Both	Whole	25				0.1	-
	1978	Both	Whole	20				0.3	-
	1979	Both	Whole	20	0.1	0.1	0.2	0.2	0.4

[a]Calculated, based on assumed daily total dietary consumption of 1.5 kg

*Maximum

Table VIII Summary of data, polychlorinated biphenyls in total diet

Country	Year	Food Origin	Part of Country	Number of Samples	Level, µg/kg Diet		Intake, µg/person/day		
					Median	90th perc.	Median	Mean	90th perc.
Canada	1977	Both	Whole	20			0.1		-
Guatemala	1979	Domestic	Part	1	<2.0	-	<3.0[a]		
	1979	Domestic	Part	1	<2.0	-	<3.0[a]		
Japan	1979	Both	Whole	10			2.9	3.0	6.0*
United Kingdom	1974	Both	Whole	27	<10	-	<15	-	-
USA	1972	Both	Whole	35				0.3	-
	1973	Both	Whole	30				1.1	-
	1974	Both	Whole	30				0.4	-
	1975	Both	Whole	20				<0.1	-
	1976	Both	Whole	20				<0.1	-
	1977	Both	Whole	25				1.1	-
	1978	Both	Whole	20				1.9	-
	1979	Both	Whole	20	0.01	1.9	0.04	1.0	5.2

[a]Calculated, based on assumed daily total dietary intake of 1.5 kg

*Maximum

Table IX Summary of data, lead in total diet

Country	Year	Food Origin	Part of Country	Number of Samples	Level, μg/kg Diet Median	Level, μg/kg Diet 90th perc.	Intake, μg/person/day Median	Intake, μg/person/day Mean	Intake, μg/person/day 90th perc.
Austria	1978	Both	Part	400	33.6	59.0	55.3		97.0
Canada	1971	Both	Part	4			148		-
	1972	Both	Part	4			77		-
Guatemala	1979	Domestic	Part	1	150	-	225[a]		
	1979	Domestic	Part	1	160	-	240[a]		
Hungary	1978	Domestic	Part	10	40	60	60[a]		90[a]
	1978	Domestic	Part	10	63	97	94[a]		145[a]
	1978	Domestic	Part	10	21	48	31[a]		72[a]
	1978	Domestic	Part	10	40	52	60[a]		78[a]
	1978	Domestic	Part	10	10	31	15[a]		46[a]
	1978	Domestic	Part	10	37	76	55[a]		114[a]
	1978	Domestic	Part	10	40	48	60[a]		72[a]
	1978	Domestic	Part	10	51	81	76[a]		121[a]
	1978	Domestic	Part	18	12	67	18[a]		100[a]
	1978	Domestic	Part	12	13	64	19[a]		96[a]
	1979	Domestic	Part	10	41	62	61[a]		93[a]
	1979	Domestic	Part	10	85	171	127[a]		256[a]
	1979	Domestic	Part	10	42	63	63[a]		94[a]
	1979	Domestic	Part	10	53	117	79[a]		175[a]
	1979	Domestic	Part	10	68	86	102[a]		129[a]
	1979	Domestic	Part	10	31	46	46[a]		69[a]
	1979	Domestic	Part	10	59	85	88[a]		127[a]
	1979	Domestic	Part	21	50	80	75[a]		120[a]
Japan	1979	Both	Whole	10			53	82.1	287*
New Zealand	1975 Grain & Cereal Products	Both	Whole	16	130	250	42.4		81.5

Table IX (cont.)

Country	Year	Food Origin	Part of Country	Number of Samples	Level, μg/kg Diet		Intake, μg/person/day		
					Median	90th perc.	Median	Mean	90th perc.
New Zealand (cont.)	Meat, fish, eggs	Domestic	Whole	16	73	120	23.4		38.5
	Dairy Products	Domestic	Whole	16	29	53	15.1		27.6
	Vegetables	Domestic	Whole	16	50	94	28.7		53.9
	Fruit	Both	Whole	16	96	340	18.3		64.9
	Confections, beverages	Both	Whole	16	26	62	22.1		52.8
	Imported fruit, etc	Imported	Whole	4	170	170	10.0		10.0
	Canned fruit, etc	Both	Whole	16	220	320	101.9		148.2
	Total Diet	Both	Whole	16			262.6[b]		477.4[b]
United Kingdom	1971	Both	Whole	24	96	-	175	193	-
	1972	Both	Whole	37	76	-	129	152	-
	1974	Both	Whole	26	65	-	140	153	-
	1975	Both	Whole	21	54	-	92	115	-
	1976	Both	Whole	25	47	-	96	105	-
	1977	Both	Whole	25	48	-	99	98	-
	1978	Both	Whole	16	44	-	97	105	-
USA	1973	Both	Whole	30				60.4	-
	1974	Both	Whole	30				90.0	-
	1975	Both	Whole	20				67.2	-
	1976	Both	Whole	20				71.2	-
	1977	Both	Whole	25				79.4	-
	1978	Both	Whole	20				95.0	-
	1979	Both	Whole	20	26	42	75.3	81.6	117

[a]Calculated, based on assumed daily total dietary consumption of 1.5 kg

[b]Summation of intakes from each of above foods

*Maximum

Table X Summary of data, cadmium in total diet

Country	Year	Food Origin	Part of Country	Number of Samples	Level, µg/kg Diet		Intake, µg/person/day		
					Median	90th perc.	Median	Mean	90th perc.
Austria	1978	Both	Part	400	15.2	21.0	25		34
Canada	1971	Both	Part	4			67		-
	1972	Both	Part	4			52		-
Guatemala	1979	Domestic	Part	1	50	-	75[a]		
	1979	Domestic	Part	1	59	-	83.5[a]		
Hungary	1978	Domestic	Part	10	4.0	12.0	6.0[a]		
	1978	Domestic	Part	10	1.5	5.4	2.3[a]		
	1978	Domestic	Part	10	0.7	1.5	1.1[a]		
	1978	Domestic	Part	10	4.0	6.0	6.0[a]		
	1978	Domestic	Part	10	1.8	3.6	2.7[a]		
	1978	Domestic	Part	10	2.7	3.0	4.1[a]		
	1978	Domestic	Part	10	0.8	2.5	1.2[a]		
	1978	Domestic	Part	10	1.3	3.4	2.0[a]		
	1978	Domestic	Part	18	2.7	7.5	4.1[a]		
	1978	Domestic	Part	12	8.0	15.0	12.0[a]		
	1979	Domestic	Part	10	3.3	6.9	5.0[a]		
	1979	Domestic	Part	10	6.0	9.0	4.0[a]		
	1979	Domestic	Part	10	2.8	6.8	4.2[a]		
	1979	Domestic	Part	10	5.8	8.8	8.7[a]		
	1979	Domestic	Part	10	4.3	7.1	6.5[a]		
	1979	Domestic	Part	10	2.7	5.1	4.1[a]		
	1979	Domestic	Part	10	4.7	6.3	7.1[a]		
	1979	Domestic	Whole	21	2.0	5.0	3.0[a]		
Japan	1979	Both	Whole	10	30.0		41.9	46.2	69*
New Zealand	1975 Grain & Cereal Products	Both	Whole	16	7.0	60	2.3		19.6

Table X (cont.)

Country	Year	Food Origin	Part of Country	Number of Samples	Level, µg/kg Diet		Intake, µg/person/day		
					Median	90th perc.	Median	Mean	90th perc.
New Zealand (cont.)	Meat, fish, eggs	Domestic	Whole	16	7.0	170	2.3		54.6
	Dairy Products	Domestic	Whole	16	1.0	190	0.5		98.8
	Vegetables	Domestic	Whole	16	6.0	30	3.4		17.2
	Fruits	Both	Whole	16	1.0	10	0.2		1.9
	Confections, beverages	Both	Whole	16	1.0	25	0.9		21.3
	Imported fruit, etc	Imported	Whole	4	9.0	9	0.5		0.5
	Canned fruit, etc	Both	Whole	16	3.0	36	1.4		16.7
	Total Diet	Both	Whole	16			11.5[b]		230.6[b]
United Kingdom	1971	Both	Whole	20	12.0	-	43	58	-
	1972	Both	Whole	35	8.0	-	16	18	-
	1974	Both	Whole	26	10.0	-	19	21	-
	1975	Both	Whole	21	11.0	-	20	22	-
	1976	Both	Whole	25	10.0	-	19	20	-
	1977	Both	Whole	25	11.0	-	18	18	-
	1978	Both	Whole	16	11.0	-	19	19	-
USA	1971	Both	Whole	30				28.4	-
	1972	Both	Whole	30				37.1	-
	1973	Both	Whole	30				51.3	-
	1974	Both	Whole	30				33.6	
	1975	Both	Whole	20				33.8	-
	1976	Both	Whole	20				32.9	-
	1977	Both	Whole	25				27.1	-
	1978	Both	Whole	20				30.9	-
	1979	Both	Whole	20	10.3	19.6	29.9	33.3	54.8

[a] Calculated, based on assumed daily total dietary consumption of 1.5 kg

[b] Summation of intakes from each of above food gropus

* Maximum

Table XI Calculated daily intakes of DDT complex via breast milk (assuming a daily consumption of 120 g milk per kg body weight).

Country	Year	Part or whole of country	Sample size	Calculated daily intake µg/kg body weight	
				Median	90th perc.
Canada	1975	Whole	100	4.1	10.7
Federal Republic of Germany	1975	Whole	320	5.3	8.2
	1976	Whole	68	3.8	7.7
	1977	Whole	495	4.4	7.9
	1977	Whole	654	4.6	7.8
	1977	Whole	148	3.7	6.8
	1978	Part	435	4.2	8.4
	1979	Whole	374	5.4	11.9
Guatemala	1974	Part	81	168	588
	1974	Part	290	48	Not reported
Hungary	1976	Part	89	17.4	30.1
	1976	Part	46	16.3	35.3
	1976	Part	10	11.6	20.4
	1976	Part	10	22.8	24.6
	1978	Part	19	18.0	52.8
	1978	Part	20	38.4	97.2
	1978	Part	20	63.6	132
	1978	Part	20	57.6	114
	1978	Part	21	31.2	54
Japan	1971	Whole	603	5.4	13.2
	1972	Whole	579	8.0	22.8
	1973	Whole	361	8.5	21.6
	1974	Whole	287	7.4	19.2
	1975	Whole	333	6.5	15.6
	1976	Whole	350	5.5	14.4
	1977	Whole	265	6.0	14.4
	1978	Whole	327	3.8	11.6
	1979	Whole	365	4.4	11.2
Sweden	1971	Part	12	9.4	10.7
	1972	Part	46	9.4	12.0
	1974	Part	15	7.9	10.2
	1977	Part	97	6.4	8.2
	1979	Part	41	5.5	13.2
Switzerland	1973	Part	15	9.0	14.9
USA	1972	Part	40	10.9	24.4
	1974	Part	57	26.4	69.6
	1975	Whole	1436	8.4	22.6

Table XII Calculated daily intakes of gamma-HCH via breast milk (assuming a daily consumption of 120 g milk per kg body weight)

Country	Year	Part or whole of country	Sample size	Calculated daily intake µg/kg body weight	
				Median	90th perc.
Federal Republic of Germany	1975	Whole	320	0.29	0.79
	1976	Whole	68	0.19	0.67
	1977	Whole	495	0.22	0.70
	1977	Whole	654	0.25	0.83
	1977	Whole	148	0.17	0.54
	1978	Part	435	0.33	0.87
	1979	Whole	374	0.11	0.39
Hungary	1976	Part	10	2.3	2.4
	1976	Part	10	2.4	3.2
Netherlands	1972	Whole	202	0.36	0.36
Switzerland	1978	Part	51	0.02	0.05

Tabel XIII Calculated daily intakes of heptachlor + heptachlor epoxide via breast milk (assuming a daily consumption of 120 g milk per kg body weight).

Country	Year	Part or whole of country	Sample size	Calculated daily intake µg/kg body weight	
				Median	90th perc.
Japan	1971	Whole	108	0.12	0.24
	1972	Whole	283	0.12	0.48
	1973	Whole	112	0.12	0.96
	1974	Whole	131	0.12	0.36
	1975	Whole	49	0.12	0.24
	1976	Part	31	0.04	0.34
	1977	Part	13	0.02	0.02
	1978	Whole	26	0.24	0.36
Switzerland	1973	Part	15	0.12	0.19
Federal Republic of Germany (data for heptachlor epoxide only)	1975	Whole	320	0.41	0.95
	1976	Whole	68	0.11	0.19
	1977	Whole	494	0.13	0.31
	1977	Whole	653	0.14	0.62
	1977	Whole	147	0.11	0.24
	1978	Part	435	0.07	0.18
	1979	Whole	374	0.04	0.14

Table XIV Calculated daily intakes of aldrin + dieldrin via breast milk (assuming a daily consumption of 120 g milk per kg body weight)

Country	Year	Part or whole of country	Sample size	Calculated daily intake µg/kg body weight	
				Median	90th perc.
Japan	1971	Whole	608	0.24	1.08
	1972	Whole	581	0.36	1.08
	1973	Whole	376	0.36	0.72
	1974	Whole	242	0.24	0.84
	1975	Whole	348	0.24	0.60
	1976	Whole	157	0.24	0.72
	1977	Whole	46	0.24	0.60
	1978	Whole	51	0.13	0.48
	1979	Whole	53	0.16	0.36
Switzerland	1973	Part	15	0.54	1.02

ABBREVIATIONS

BHC	benzenehexachloride (or hexachlorocyclohexane)
DDE	1,1'-(2,2-dichloroethenylidene)-bis[4-chlorobenzene]
DDT	1,1'-(2,2,2-trichloroethylidene -bis[4-chlorobenzene]
HCB	hexachlorobenzene
HCH	hexachlorocyclohexane (or benzenehexachloride)
α-HCH	alpha-hexachlorocyclohexane
β-HCH	beta-hexachlorocyclohexane
γ-HCH (lindane)	gamma-hexachlorocyclohexane
PCB	polychlorinated biphenyls
TDE (DDD)	1,1'-(2,2-dichloroethylidene)-bis[4-chlorobenzene]
ADI	acceptable daily intake
AQA	Analytical Quality Assurance
FAO	United Nations Food and Agriculture Organization
GEMS	Global Environmental Monitoring System
IARC	International Agency for Research on Cancer
JECFA	Joint FAO/WHO Expert Committee on Food Additives
JMPR	Joint Meeting on Pesticide Residues
UNEP	United Nations Environment Programme
WHO	World Health Organization