CONTENTS

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* New compound

** Evaluated within the periodic review programme of the Codex Committee on Pesticide Residues

[1]T, Toxicological evaluation; R, residue and analytical aspects; D, dietary risk assessment

List of participants

2000 Joint FAO/WHO Meeting on Pesticide Residues
Geneva, 20–29 September 2000

WHO Members

Professor A.R. Boobis, Section on Clinical Pharmacology, Division of Medicine, Imperial College School of Medicine, Hammersmith Campus, Ducane Road, London W12 0NN, United Kingdom

Professor J.F. Borzelleca, Department of Pharmacology, Toxicology, Medical College of Virginia, Virginia Commonwealth University, (H) 8718 September Drive, Richmond, VA 23229-7319, USA

Dr P. Fenner-Crisp, Senior Science Advisor to the Director, Office of Pesticide Programs (7501C), US Environmental Protection Agency, 401 M Street SW, 20460 Washington DC, USA

Dr H. Hakansson, Institute of Environmental Medicine, Karolinska Institutet, Division of Risk Assessment and Organohalogen Pollutants, Box 210, 171 77 Stockholm, Sweden

Professor J. Hajslova, Institute of Chemical Technology, Department of Food Chemistry and Analysis, Technickà 3, 166 28 Prague 6, Czech Republic

Dr A. Moretto, Department of Environmental Medicine and Public Health, Università di Padova, via Giustiniani 2, 35128 Padova, Italy *(Chairman)*

Professor S.A. Soliman, Department of Pesticide Chemistry, Faculty of Agriculture, Alexandria University, El-Shatby, Alexandria 21545, Egypt

Dr B.G. Priestly, Scientific Director, Chemicals & Non-Prescription Medicines Branch, Therapeutic Goods Administration, Commonwealth Department of Health and Aged Care, PO Box 100, Woden, ACT 2606, Australia *(Rapporteur)*

FAO Members

Dr Ursula Banasiak, Federal Biological Research Centre for Agriculture and Forestry, Stahnsdorfer Damm 81, 14532 Kleinmachnow, Germany

Dr Susan May F. Calumpang, National Crop Protection Center, University of the Philippines, Los Baños, Laguna, Philippines

Dr Eloisa Dutra Caldas, University of Brasilia, College of Health Sciences, Pharmaceutical Sciences Department, Campus Universitàrio Darci Ribeiro, 70919-970 Brasília/DF, Brazil *(Rapporteur)*

Dr Stephen Funk, Health Effects Division (7509C), US Environmental Protection Agency, 1200 Pennsylvania Ave NW, Washington DC 20460, USA

Mr D.J. Hamilton, Principal Scientific Officer, Animal & Plant Health Service, Floor 3PIB, Department of Primary Industries, PO Box 46, Brisbane, Queensland 4001, Australia *(Vice-Chairman)*

Mr Kazuo Ogura, Agricultural Chemicals Inspection Station, Suzuki-cyo 2-772, Kodairi-shi, Tokyo 187-0011, Japan

Dr Bernadette C. Ossendorp, Centre for Substances and Risk Assessment, National Institute of Public Health and the Environment (RIVM), Antonie van Leewenhoeklaan 9, PO Box 1, 3720 BA Bilthoven, The Netherlands

Secretariat

Dr Fernando Aguilar, International Programme on Chemical Safety, World Health Organization, 1211 Geneva 27, Switzerland

Dr I.C. Dewhurst, Pesticides Safety Directorate, Mallard House, King's Pool, 3 Peasholme Green, York YO1 7PX, United Kingdom (*WHO Temporary Adviser*)

Dr V.A. Dobozy, Health Effects Division (7509C), Office of Pesticide Programs, US Environmental Protection Agency, Ariel Rios Building, 1200 Pennsylvania Avenue NW, 20460 Washington DC, USA (*WHO Temporary Adviser*)

Dr W.H. van Eck, Chairman, Codex Committee on Pesticide Residues, Division of Public Health, Ministry of Health and Welfare and Sport, PO Box 20350, 2511 VX Den Haag, The Netherlands

Dr J. van Engelen, Centre for Substances and Risk Assessment, National Institute of Public Health and the Environment (RIVM), Antonie van Leeuwenhoeklaan 9, PO Box 1, 3720 BA Bilthoven, The Netherlands (*WHO Temporary Adviser*)

Dr John L. Herrman, International Programme on Chemical Safety, World Health Organization, 1211 Geneva 27, Switzerland (*WHO Joint Secretary*)

Dr M. Hirose, Head, Division of Pathology, National Institute of Health Sciences, 1-18-1 Kamiyoga, Setagaya-ku, Tokyo 158-8501, Japan (*WHO Temporary Adviser*)

Dr Dugald MacLachlan, Chemistry & Residues Evaluation Section, National Registration Authority for Agricultural & Veterinary Chemicals, 22 Brisbane Avenue, PO Box E 240, Kingston, ACT 2604, Australia (*FAO Consultant*)

Dr T.C. Marrs, Food Standards Agency, Skipton House, 80 London Road, Elephant and Castle, London SE1 6LW, United Kingdom (*WHO Temporary Adviser*)

Dr D.B. McGregor, 102 rue Duguesclin, 69006 Lyon, France (*WHO Temporary Adviser*)

Dr Gerry Moy, Food Safety, World Health Organization, 1211 Geneva 27, Switzerland

Dr U.W. Mueller, Chemicals & Non-Prescription Medicines Branch, Therapeutic Goods Administration, Commonwealth Department of Health and Aged Care, PO Box 100, Woden, ACT 2606, Australia (*WHO Temporary Adviser*)

Ms Barbara Röstel, Chef d'unité Relations internationals, ANMV–AFSSA, BP 90203, 35302 Fougères Cedex, France (*FAO Consultant*)

Dr R. Solecki, Pesticides and Biocides Division, Federal Institute for Health Protection of Consumers and Veterinary Medicine, Thielallee 88-92, 14195 Berlin, Germany (*WHO Temporary Adviser*)

Dr A.W. Tejada, Pesticide Management Group, Plant Protection Service, Plant Production and Protection Division, Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, 00100 Rome, Italy (*FAO Joint Secretary*)

Dr Yukiko Yamada, Food Standards Officer, Joint FAO/WHO Standards Programme, Food and Nutrition Division, Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, 00100 Rome, Italy

Abbreviations

(Well-known abbreviations in general use are not included)

Ache	acetylcholinesterase
acute RfD	acute reference dose
ADI	acceptable daily intake
AFI(D)	alkali flame-ionization (detector)
ai	active ingredient
ALAT	alanine aminotransferase
AR	applied radioactivity
ASAT	aspartate aminotransferase
BBA	Biologische Bundesanstalt für Land- und Forstwirtschaft
bw	body weight
BOD	biological oxygen demand
CA	Chemical Abstracts
CAS	Chemical Abstracts Services
CCN	Codex Classification Number (this may refer to classification numbers for compounds or for commodities)
CCPR	Codex Committee on Pesticide Residues
CCRVDF	Codex Committee on Residue of Veterinary Drugs in Food
ChE	cholinesterase
CI	chemical ionization
CNS	central nervous system
cv	coefficient of variation
CXL	Codex Maximum Residue Limit (Codex MRL). See MRL.
DFG	Deutsche Forschungsgemeinschaft
DL	racemic (optical configuration, a mixture of dextro- and laevo-)
DP	dustable powder
DS	powder for dry seed treatment
DT-50	time for 50% decomposition (i.e. half-life)
DT-90	time for 90% decomposition
EBDC	ethylenebis(dithiocarbamate)
EC	(1) emulsifiable concentrate (2) electron-capture [chromatographic detector]
ECD	electron-capture detector
EI	electron-impact
EMDI	estimated maximum daily intake
EPA	Environmental Protection Agency
ERL	extraneous residue limit
ETU	ethylenethiourea
F_1	filial generation, first
F_2	filial generation, second
f.p.	freezing point
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration
FI(D)	flame-ionization (detector)
FP(D)	flame-photometric (detector)

g	gram
µg	microgram
GAP	good agricultural practice(s)
GC-MS	gas chromatography - mass spectrometry
GC-MSD	gas chromatography with mass-selective detection
G.I.	gastrointestinal
GL	guideline level
GLC	gas-liquid chromatography
GLP	good laboratory practice
GPC	gel-permeation chromatograph or chromatography
GSH	glutathione
h	hour(s)
ha	hectare
Hb	haemoglobin
hl	hectolitre
HPLC	high-performance liquid chromatography
HPLC-MS	high-performance liquid chromatography - mass spectrometry
HR	highest residue in the edible portion of a commodity found in the trials used to estimate a maximum residue level in the commodity
HR-P	residue in a processed commodity calculated by multiplying the HR of the raw agricultural commodity by the corresponding processing factor
i.d.	internal diameter
IEDI	international estimated daily intake
IESTI	international estimate of short-term intake
i.m.	intramuscular
i.p.	intraperitoneal
IPCS	International Programme on Chemical Safety
IR	infrared
IRDC	International Research and Development Corporation (Mattawan, Michigan, USA)
i.v.	intravenous
JMPR	Joint FAO/WHO Meeting on Pesticide Residues (Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and the WHO Core Assessment Group
LC	liquid chromatography
LC_{50}	lethal concentration, 50%
LC-MS	liquid chromatography - mass spectrometry
LD_{50}	lethal dose, median
LOAEL	lowest observed adverse effect level
LOD	limit of determination (see also "*" at the end of the Table)
LSC	liquid scintillation counting or counter
M	molar
µm	micrometre (micron)
MFO	mixed function oxidase
min	minute(s)
(no stop)	
MLD	minimum lethal dose

mo	month(s)
MRL	Maximum Residue Limit. MRLs include draft MRLs and Codex MRLs (CXLs). The MRLs recommended by the JMPR on the basis of its estimates of maximum residue levels enter the Codex procedure as draft MRLs. They become Codex MRLs when they have passed through the procedure and have been adopted by the Codex Alimentarius Commission.
MS	mass spectrometry
MSD	mass-selective detection or detector
MTD	maximum tolerated dose
n (not *n*)	normal (defining isomeric configuration)
NCI	National Cancer Institute (USA)
NMR	nuclear magnetic resonance
NOAEL	no-observed-adverse-effect level
NOEL	no-observed-effect level
NP(D)	nitrogen-phosphorus (detector)
NTE	neuropathy target esterase
OECD	Organization for Economic Co-operation and Development
OP	organophosphorus pesticide
PHI	pre-harvest interval
ppm	parts per million. (Used only with reference to the concentration of a pesticide in a diet. In all other contexts the terms mg/kg or mg/l are used).
PT	prothrombin time
PTDI	provisional tolerable daily intake. (See 1994 report, Section 2.3, for explanation)
PTT	partial thromboplastin time
PTU	propylenethiourea
RAC	raw agricultural commodity
RBC	red blood cell
r.d.	relative density. (Formerly called specific gravity)
RfD	reference dose (usually in the phrase 'acute reference dose')
s.c.	subcutaneous
SC	suspension concentrate (= flowable concentrate)
SD	standard deviation
SE	standard error
SG	water-soluble granule
SL	soluble concentrate
SP	water-soluble powder
sp./spp.	species (only after a generic name)
SPE	solid-phase extraction
STMR	supervised trials median residue
t	tonne (metric ton)
T_3	tri-iodothyronine
T_4	thyroxine
TADI	Temporary Acceptable Daily Intake
tert	tertiary (in a chemical name)
TLC	thin-layer chromatography
TMDI	theoretical maximum daily intake
TMRL	Temporary Maximum Residue Limit

TRR	total radioactive residue
TSH	thyroid-stimulating hormone (thyrotropin)
UDMH	1,1-dimethylhydrazine (unsymmetrical dimethylhydrazine)
USEPA	United States Environmental Protection Agency
USFDA	United States Food and Drug Administration
UV	ultraviolet
WG	water-dispersible granule
WHO	World Health Organization
WP	wettable powder
<	less than
≤	less than or equal to
>	greater than
≥	greater than or equal to
*	at or about the limit of determination

PESTICIDE RESIDUES IN FOOD

REPORT OF THE 2000 FAO/WHO JOINT MEETING OF EXPERTS

1. INTRODUCTION

A Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and the WHO Core Assessment Group on Pesticide Residues (JMPR) was held at WHO, Geneva (Switzerland), from 20 to 29 September 2000. The FAO Panel of Experts had met in preparatory sessions from 15 to 19 September.

The Meeting was opened by Mr D. Aitken, Senior Policy Adviser to the WHO Director-General, on behalf of the Directors General of FAO and WHO. Mr Aitken stressed the important issues to be considered at the Meeting, including further development of the acute reference dose and methods for assessing short-term intake, further consideration of risks posed by pesticides to infants and children, the appropriate use of studies of processing, and issues relating to transparency. He also noted the importance of Environmental Health Criteria 104, *Principles for the toxicological assessment of pesticide residues in food*, in providing a basis for consistent, credible toxicological evaluations over the past 10 years. In view of the tremendous scientific advances that have been made during that time, the increasing complexity and scope of the evaluations of JMPR, the formal use of principles for risk analysis in the development of food standards, the introduction of the concept of the acute reference dose, and increased emphasis on intake assessments, FAO and WHO are considering updating and consolidating risk assessment principles as they relate to toxicity, intake, residues, and specifications, as appropriate, for pesticides, veterinary drugs, food additives, and contaminants.

The Meeting was held in pursuance of recommendations made by previous Meetings and accepted by the governing bodies of FAO and WHO that studies should be undertaken jointly by experts to evaluate possible hazards to humans arising from the occurrence of residues of pesticides in foods. The reports of previous Joint Meetings (see Annex 6) contain information on acceptable daily intakes (ADIs), maximum residue limits (MRLs), and the general principles that have been used for evaluating pesticides. The supporting documents (residue and toxicological evaluations) contain detailed monographs on these pesticides and include evaluations of analytical methods.

During the Meeting, the FAO Panel of Experts was responsible for reviewing residue and analytical aspects of the pesticides under consideration, including data on their metabolism, fate in the environment, and use patterns, and for estimating the maximum levels of residues that might occur as a result of use of the pesticides according to good agricultural practice. The WHO Core Assessment Group was responsible for reviewing toxicological and related data and for estimating, where possible, ADIs and provisional tolerable daily intakes (PTDIs).

The Meeting evaluated 20 pesticides, including one new compound and 10 compounds that were re-evaluated within the periodic review programme of the Codex Committee on Pesticide Residues (CCPR) for toxicology or residues or both. One contaminant, DDT, was also evaluated.

The Meeting allocated ADIs, PTDIs, and acute reference doses (RfDs), estimated MRLs and recommended them for use by the CCPR, and estimated supervised trials median residue (STMR) and highest residue (HR) levels as a basis for estimating dietary intakes.

The Meeting devoted particular attention to estimating the dietary intakes (both short-term and long- term) of the pesticides reviewed in relation to their ADIs or acute RfDs. In particular, for compounds undergoing a complete evaluation or re-evaluation, it distinguished between those for which the estimated intake is below the ADI and those for which the intake might exceed the ADI. Footnotes are used to indicate those pesticides for which the available information indicates that the ADI might be exceeded, and footnotes are used to denote specific commodities in which the available information indicates that the acute RfD of the pesticide might be exceeded. A proposal to make this distinction and its rationale are described in detail in the reports of the 1997 JMPR (Annex 6, reference 80, section 2.3) and 1999 JMPR (Annex 6, reference 86, section 2.2).

2. GENERAL CONSIDERATIONS

2.1 Progress on estimation of acute dietary intake: International estimates of short-term dietary intake

The method for calculating an international estimate of short-term dietary intake (IESTI) was first developed by the Geneva Consultation in 1997, and was used by the JMPR at its 1999 Meeting (Annex 6, reference 86, section 3), after refinements made subsequently.The method is still being improved, however, in the light of experience gained in its application.

The IESTI for commodities for which the unit weight, *U*, of the whole portion is less than that of a large portion, *LP*, was defined as

$$\text{IESTI} = \frac{U * (\text{HR or HR-P}) * \nu + (LP - U) * (\text{STMR or STMR-P})}{bw}$$

where *HR* is the highest concentration of residue found in the edible portion of a commodity in trials in which the maximum residue level was evaluated, *HR-P* is the concentration of residue in a processed commodity, calculated by multiplying the HR of the raw agricultural commodity by the corresponding processing factor, *STMR* is the value of the supervised trials median residue, and *STMR-P* is the value of median residue in supervised trials of the processed commodity.

The Meeting noted that this approach is based on the assumption that the units that comprise a portion may be derived from different lots. In that case, the first unit would contain residues at the level of [HR x ν], where ν is a variability factor, and the subsequent ones would contain residues at the STMR level, which is the median value of residues in different lots. The Meeting agreed that this assumption might not reflect the actual situation, in which the supply available for consumption is likely to be derived from a single lot. In this case, the values STMR and STMR-P in the second part of the equation, which accounts for the intake of residue from consumption of all but the first unit, should be replaced by HR and HR-P:

$$\text{IESTI} = \frac{U * (\text{HR or HR-P}) * \nu + (LP - U) * (\text{HR or HR-P})}{bw}$$

Calculation of the IESTI from data on animal commodities was first applied at the present Meeting and had not been considered before. According to the recommended sampling principles (Codex Alimentarius, 1993), "a lot would comply with the MRL if (a) the final sample (consisting of combined primary samples) of commodities other than meat and poultry products did not contain a residue above the MRL, or (b) none of the primary samples of meat and poultry products analyzed contained a residue above the MRL". This implies that a variability factor, ν, should not be used in calculating IESTIs for animal commodities. Furthermore, the Meeting agreed that the short-term intake due to consumption of animal commodities, except milk, should be estimated as for Case 1 in the method. For milk, Case 3 should be applied, which involves bulking or blending large portions at the STMR level.

2.2 Relevance of food processing questionnaires for JMPR evaluations

To assist in the interpretation of processing studies submitted to the Meeting, the WHO Global Environment Monitoring System—Food Contamination Monitoring and Assessment Programme (GEMS/Food) has developed a questionnaire designed to obtain more detailed and accurate information on food processing practices in various countries.

At the 2000 meeting of the CCPR, the USA, and the Global Crop Protection Federation asked for further information on the use of such processing data by JMPR, especially in the light of the current data requirements of the Meeting concerning the fate of residues during processing. The CCPR requested the Meeting to comment on whether new requirements for generation of data will be developed, or if default processing factors will be used. The CCPR agreed to forward the questionnaire to the Meeting to obtain comments on use of the resulting information on food processing (ALINORM 01/24, paragraphs 39–43).

The general principles, the objectives, and the procedure used currently by the Meeting for evaluating processing studies are described in the *FAO Manual* (FAO, 1997) and in the report of the1999 Meeting (Annex 6, reference 86) . The processing studies are evaluated in essentially the same way as reports of supervised trials. The members of the FAO Panel of the Meeting check:

- the analytical methods, including validation of the sample and its stability on storage in a freezer;
- the conditions of the field trial in which the raw agricultural commodity was produced; and
- the conditions of the process, such as the technique and amount of commodity processed.

After reviewing the studies, the Meeting can calculate processing factors or conclude that the studies are not appropriate (e.g. the concentrations of residues in the raw commodity are too low or those in the processed commodity are not detectable) or inadequate to derive factors. The processing factors are applied to the MRLs and STMR values of the raw commodities to derive values for processed commodities. The Meeting assumes that the processing studies, like supervised trials, are performed according to national registration requirements, which take into account national practices.

The purposes of the questionnaire, as defined by GEMS/Food, are to identify:

- the commonest forms of consumption of specific commodities, in order to incorporate processing factors into dietary intake assessments at the international level (Part A) and
- characteristic parameters of industrial or the household processing and preparation procedures identified above as a basis for planning appropriate studies of the post-harvest fate of residues (Part B).

Consumption patterns in the five GEMS/Food regional diets are currently based on food balance sheets of raw agricultural commodities, and the predominant processing practice used nationally or regionally is not always identified. The Meeting therefore welcomed use of the questionnaire to fill in gaps in knowledge about the typical methods of processing of raw agricultural commodities in these diets for use in dietary risk assessment. The Meeting noted that data on consumption are not available for important processed foods such as juices of apples, sour cherries, citrus fruit, black currants, grapes, pineapple, and tomato or for wine, tomato paste, barley beer, maize meal, and bran of rye and wheat. In these cases, even when processing data are available, short-term or long-term dietary intake cannot be determined.

The Meeting recognized that important processed commodities are processed in almost identical ways world wide, and, consequently, processing data generated according to national requirements are applicable for international assessments. Any significant differences in processing techniques from one region to another would be revealed in responses to the questionnaire.

The JMPR will continue to evaluate processing data as described in the *FAO Manual.* No default factors will be applied and no new requirements will be imposed upon data submitters. The Meeting recognized that the questionnaire serves as a basis for defining appropriate processed commodities and recommended that GEMS/Food use the information from the questionnaire to revise or develop data on food consumption for assessing short-term and long-term dietary intake .

2.3 Measures to be taken when estimated dietary intake exceeds the acceptable daily intake

At the 2000 meeting of the CCPR, the Delegate of Australia proposed a number of measures that might be used in situations in which the international estimated daily intake (IEDI) indicates that the ADI might be exceeded (CX/PR 00/7). One approach was based on improving estimates of dietary intake. To that end, the CCPR asked the Meeting to consider:

- use of contemporary national reviews and dietary intake calculations as an adjunct to the assessments of the Meeting (section 22(b)).
- changes to the JMPR procedures, whereby manufacturers and other data submitters would be expected routinely to include dietary intake estimates in accordance with the JMPR method (section 22(c)).

On the first point, the Meeting considered that national reviews and dietary intake calculations have little relevance to the work of the Meeting at the international level in estimating long-term dietary intake in the five GEMS/Food regional diets. In national reviews and calculations, exposure is typically refined by the inclusion of data on the per cent of crop treated , typical use, data from monitoring and market basket surveys, and data on processing. While these factors are appropriate at the national level, the per cent of crop treated, typical use, and data from surveys are not useful at the international level. The Meeting bases its recommendations for MRLs in commodities on the results of field trials conducted under good agricultural practices (GAP). The trials are usually conducted by manufacturers or other interested parties, such as minor crop organizations, in accordance with the guidelines of one or more target nations. For a given commodity, the Meeting receives reports of GAP trials from several countries and combines the data for comparable populations of residues.

Application of a value for per cent of crop treated in one country to all available data on residues or to data for selected regions would not be appropriate. Furthermore, the per cent of crop treated varies from year to year with pest pressure and market conditions, and only national governments are in a position to assess this factor and to adjust the intakes if required. The same consideration applies to the application of typical practice conditions to the data from field trials. This information is nation-specific and cannot be applied routinely to data from other nations. Data from surveys are very useful at the national level for estimating dietary intake, as they are close to actual consumption and provide a realistic estimate of the actual concentration of a pesticide in food. At the international level, data from surveys in one or several countries cannot be extended to other regional diets or even within a regional diet grouping; for example, market basket surveys in the USA may not be applicable to Europe. Data from surveys are not universal, and the vast majority represent only a few nations.

Data on processing from national sources are applicable at the international level, where they are used to estimate changes in the concentrations of residues in processed commodities relative to those in raw agricultural commodities, such as orange juice from oranges. Such studies, provided by manufacturers, are based on validated national procedures and have usually been approved by a national authority. The processing factors derived from these studies permit refined calculations for processed commodities, provided that data on consumption in the GEMS/Food regional diets are available .

Processing studies additional to those provided by the manufacturer are sometimes available in national reviews and assessments, and the results of such studies would be welcomed by the Meeting. Additional studies on the processing of a commodity are desirable in order to give greater credibility to the average factors calculated. Furthermore, manufacturers rarely submit processing studies on all relevant commodities. For instance, a manufacturer may submit studies on one grain or oilseed, whereas the MRL may be relevant for several grains or oilseeds. The Meeting commented that any

additional data on processing would be of limited value unless the GEMS/Food regional diets are expanded to include more processed commodities. For example, although studies on apple processing are often received, allowing the Meeting to estimate the residues in apple juice, no data on the consumption of apple juice are available in the GEMS/Food database.

On the second suggestion made by the Delegate of Australia at the 2000 meeting of the CCPR, the Meeting considered that calculations of dietary intake provided by manufacturers are of no use in the JMPR evaluation system. Even though some manufacturers have supplied dietary intake calculations conducted in accordance with the JMPR method, the calculations are of no practical value because they are based on the manufacturer's interpretation of the results of field trials and of data on processing. Furthermore, their data may be incomplete, since the meeting may have access to the results of additional trials submitted by governments or other manufacturers. The Meeting must evaluate the field trials and subsequently estimate STMR and STMR-P values. The calculations of dietary intake cannot be finalized until these values have been established by deliberations at the Meeting. Estimation of long-term dietary intake is an integral part of the review process and cannot be done effectively outside that process.

The Meeting concluded that national determinations of dietary intake are useful only at the national level and can be used at that level to refine the estimates made by JMPR. The Meeting further concluded that dietary intake calculations performed by manufacturers in support of compounds under periodic review or newly evaluated are of little relevance, because the field trials must first be assessed and STMR and STMR-P values developed by the Meeting.

2.4 Feasibility of establishing maximum residue limits for genetically modified crops and for residues of metabolites

At the thirty-first session of the CCPR (Alinorm 99/24A, para 105), several delegates expressed reservations regarding establishment of MRLs for residues of a metabolite resulting from treatment of a genetically modified commodity with glyphosate. They requested a clear policy on a number of issues related to genetically modified crops. The Committee agreed that a short paper should be prepared for consideration at its next session. At the thirty-second session of the CCPR (Alinorm 01/24, para 61–66), a paper prepared by Canada in collaboration with Australia, the USA, GCPF, and the Codex Secretariat was presented (ftp://ftp.fao.org/codex/olddocs/committee/ccpr32/pr00_08e.doc). The Committee approved the paper in general but asked Canada to incorporate the remarks made and to prepare a revised version for its next session. In the meantime, the Committee requested JMPR to discuss the report.

The Meeting welcomed the paper and recalled that it had already evaluated some pesticides used on genetically modified crops and, in doing so, took into account the same issues, such as metabolism and analytical methods, as it does when evaluating a pesticide used solely on non-transgenic crops in establishing a residue definition. The Meeting fully recognized the complexity of such evaluations, for instance in cases in which an analyte in a non-transgenic crop is the major metabolite in the genetically modified crop. The Meeting stressed that when a non-transgenic crop of a commodity cannot be readily distinguished from the genetically modified crop, the residue definition should be the same for both. The Meeting considered that no one approach is applicable to all situations and that a case-by-case approach should be used at present. The Meeting looked forward to receiving reports of further discussions within Codex on this topic.

2.5 Minimum data required for establishing maximum residue limits, including import tolerances

At its thirty-first session, the CCPR decided to refer to the JMPR the recommendations of a workshop organized by OECD and held at the Pesticide Safety Directorate, York, United Kingdom, in 1999 on minimum data requirements for establishing MRLs, including import tolerances, and asked for comments to be made available for the 2001 meeting of the CCPR.

The JMPR in 1994 (Annex 6, reference 71) had noted the need for internationally agreed minimum data requirements from supervised trials for establishing MRLs, and the present Meeting welcomed the lead taken by the OECD in this area. The guidance document was considered generally to reflect current JMPR practices.

Comments on a draft copy of the document were provided to the CCPR by the 1999 Meeting (Annex 6, reference 86) .

The main purpose of the workshop was to facilitate harmonization of requirements for trials used for setting MRLs and import tolerances. The areas identified during the workshop as requiring harmonization were suitable climate zones for residue trials, criteria for determining the minimum number of trials required, and extrapolation of data on residues in one crop to support an MRL for a related crop. The comments of the Meeting on these points are as follows:

- *Climate zones*: The generation of maps of equivalent climate zones among which data from residue trials could be transposed, if based on sound science, could aid the JMPR in estimating MRLs. The Meeting agreed to consider carefully any outcomes of the OECD project on climate zones, the scientific basis (for evaluating residues), and how they might be used in evaluation at an international level.
- *Minimum number of trials*: In considering the minimum acceptable number of trials (conducted according to GAP) for estimating a MRL, the Meeting currently takes into account such factors as importance in trade and in the diet. The OECD document extended the considerations to take into account various climate zones. The Meeting agreed to consider the OECD workshop proposals when they were finalized.
- *Extrapolation between crops*: One difficulty in extrapolating information on residues in one crop to another at the international level has been lack of agreement on which extrapolations are acceptable. In this area, the Meeting has taken a conservative approach. Agreement on extrapolations that are possible in principle would be useful.
- *Processing studies*: The OECD paper outlined the minimum requirements for processing studies, including possible extrapolation of processing factors from, e.g., one oilseed crop to another or carrots to tuber crops. The JMPR will follow developments in this area with interest.

The Meeting was aware of an OECD project for defining climate zones, and a meeting on this subject was held on 12–13 September 2000 in Geneva prior to the 2000 JMPR. Of particular interest to the Meeting was the plan to validate zone models on the basis of significant differences in residue levels. The Meeting looked forward to updates on follow-up to the OECD workshop.

2.6 Periodic review of data on residues of compounds currently being re-registered nationally

The 1999 Meeting noted that further consideration should be given to the timing of reviews within the CCPR periodic review programme and the submission of the required data, in particular for those compounds that are also being re-registered nationally.

In national review programmes, current uses are frequently revised substantially to meet new requirements for the safety of human health and the environment. The data submitted to the Meeting therefore often include both current registered uses and labels awaiting approval by national

authorities. Data from field trials, however, usually relate to new uses. In such cases, the Meeting cannot amend or recommend maintenance of existing MRLs. Furthermore, for some compounds, both old labels and revised labels stipulating lower rates exist simultaniously, and MRLs reflecting the adjusted uses cannot be established.

In 1999, the meeting recommended that this issue should be brought to the attention of the CCPR and invited the Committee to consider an alternative approach in the case of periodic review of a compound for which GAP is being changed significantly to meet safety requirements. For the sake of efficiency, the Meeting proposed to recommend MRLs on the basis of data reflecting the envisaged uses, provided that the notifying governments stated clearly that the old labels would be withdrawn and when.

The CCPR considered these recommendations at its thirty-second session (Alinorm 01/24, para 18), when it recognized that, in cases such as that described above, the JMPR could not finalize an evaluation at a given meeting. It could continue its review only when the revised GAP had been approved by national governments. The CCPR did not concur with the solution suggested by the Meeting. It considered that the current periodic review procedure should be maintained, but that countries should provide detailed information on the registration status of a compound at the time it was proposed for inclusion in lists of priorities and again when the compound was scheduled for review by JMPR. The CCPR considered that the amendment to the periodic review procedure proposed by the Meeting would not add to the transparancy of the process of establishing MRLs and that it would be difficult in practice to keep track of changes in GAP in registered uses.

The present Meeting considered the issue again, in the light of its evaluation of several compounds within the periodic review procedure. In order to ensure the best review of data on residues, the Meeting recommended that the following information should be submitted to the FAO Joint Secretary for compounds notified for periodic review while undergoing re-registration by national authorities:

- current registered uses
- current registered uses that will be supported
- envisaged new or amended uses
- the status of the registration and an estimate of the date on which new or amended uses will become GAP
- an estimate of the date on which old registered uses will be revoked
- a clear description of the uses (new, amended, or current but not to be supported) to which the data from supervised trials of residues relate.

The Meeting decided that, as of 2001, reviews of such compounds should focus on new or amended uses or current uses that will be supported, giving full details of the evalaution. MRLs will be recommended only for current uses. MRLs will be recommended for new and amended uses only when those uses have become GAP. Moreover, the Meeting recommended that periodic review of compounds be postponed until such time as national authorities can reasonably have finished their re-registration process.

2.7 Maintaining the independence of the JMPR decision-making process

The attention of the Meeting was drawn to a document, *Tobacco Company Strategies to Undermine Tobacco Control Activities at the World Health Organization, Report of the Committee of Experts on Tobacco Industry Documents, July 2000*, in which it is alleged that an individual exerted improper influence on the outcome of the toxicological evaluation of the ethylenebisdithiocarbamates

and ethylenethiourea by the 1993 JMPR. The Meeting recognized the seriousness of this accusation and acknowledged that the credibility of the JMPR had been damaged by the events of 1993.

The 1993 toxicological review of the ethylenebisdithiocarbamates and ethylenethiourea

The *Report of the Committee of Experts on Tobacco Industry Documents* alleges that Dr G. Vettorazzi specifically influenced the outcome of the toxicological evaluation of ethylenebisdithiocarbamates and ethylenethiourea at the 1993 Meeting. Dr Vettorazzi served as a temporary adviser at the Meeting and compiled a dossier of past international decisions on these pesticides. He was not responsible for critically evaluating dossiers of submitted data or for drafting a working paper on any of the pesticides evaluated at that Meeting. Therefore, in accordance with JMPR procedures, he did not have prior access, via the JMPR, to the dossiers of data on these pesticides.

Several persons who attended the 1993 Meeting as Members or as Temporary Advisers unanimously confirmed the view already put to the Committee of Experts, that Dr Vettorazzi had made little, if any, comment on the evaluations of ethylenebisdithiocarbamates or ethylenethiourea. While Dr Vettorazzi may have over-emphasized the extent of his influence, the assertion that he was able to exert an inappropriate influence on the outcome impugns the integrity and scientific reputation of the Members, who actually make the decisions at the JMPR.

Implicit also in the Committee's report is the conclusion that the interpretation of the data on the carcinogenic and genotoxic potential of these pesticides was flawed because it differed from the conclusions reached in the 1989 review of ethylenebisdithiocarbamates by the US Environmental Protection Agency (EPA). However, it is not unusual for the Meeting to evaluate a scientific dossier and to draw conclusions different from those made by another reviewing body or regulatory agency, as the Meeting uses its own risk assessment paradigm. Indeed, it is one of the strengths of the system that the Meeting makes an independent review of the available scientific data.

The conclusions drawn by the 1993 JMPR about the potential carcinogenicity and genotoxicity of ethylenebisdithiocarbamates and ethylenethiourea, while differing from those of the US EPA, are in fact consistent with JMPR risk assessment principles (WHO, ?). The Meeting noted that its conclusions were similar to those reached by a number of national regulatory agencies that reviewed the data on these compounds independently at about the same time. For example, in 1993–94, the European Commission reviewed the data on ethylenethiourea and four ethylenebisdithiocarbamates that generate this metabolite. None of these substances (ethylenethiourea, mancozeb, maneb, metiram, or zineb) was classified as either carcinogenic or mutagenic. The Australian regulatory authorities reached a similar conclusion in relation to ethylenethiourea in 1992–93.

The present Joint Meeting acknowledged that the scientific bases of its evaluations were not as clearly described in the report published in 1993 as they are today. The transparency of its reports and monographs has been improved considerably since that time, and the Meeting will continue to strive to improve its performance in this area.

On the basis of the above considerations, the Meeting concluded that the evaluations of the ethylenebisdithiocarbamates in 1993 were appropriate and had not been influenced by the tobacco industry. Furthermore, the Meeting concluded that the toxicological database on ethylenebisdithiocarbamates and ethylenethiourea could not be reviewed from the perspective of 1993, because of intervening developments in the understanding of the mechanism of the toxicity of such compounds.

Independence of JMPR decisions and avoidance of improper influence

The credibility of JMPR depends, among other things, on its independence and on avoidance of influence by interested parties. Members and Temporary Advisers are appointed to serve in their personal capacities and on the basis of their scientific reputations and expertise. They are not appointed to represent any government, institution, or special interest group.

Since 1993, the processes for revealing conflicts of interest have been extended and strengthened, consistent with similar exigencies around the world. The JMPR will take all possible steps to avoid repetition of a situation in which any Member or Temporary Advisor could participate in any way in a Meeting without disclosing a real or potential conflict of interest.

The Meeting acknowledged that potential conflicts of interest may arise between participants' continuing obligations to employers and/or fiduciary relationships. The Meeting emphasized that the participants must act independently, and not be beholden to any government, institution, business, or special interest group. The responsibilities and role of each person at a Joint Meeting should be clear to all other participants, in order to increase transparency both within the Meeting and from a historical perspective.

Recommendations

- When significant new toxicological data on ethylenebisdithiocarbamates and ethylenethiourea become available, it would be appropriate to schedule their re-evaluation at a time consistent with the priorities of CCPR.
- The roles of categories of participants (Members, Temporary Advisers, consultants and the WHO and FAO Secretariats) should be clarified in a revision of the procedural guidelines.
- The responsibilities and roles of each participant at each Meeting should be listed, and the Joint Secretaries should maintain the list in the appropriate archives of FAO and WHO.
- Guidelines should be developed by FAO and WHO for the maintenance of original working papers, correspondence, and other documentation relating to meetings of scientific committees.
- FAO and WHO should prepare a code of ethics for JMPR participants.
- FAO and WHO should explain more clearly their procedures for selecting experts.
- FAO and WHO should provide more guidance to participants in making their declaration of interests, in order to take account of all real, potential, or apparent conflicts.
- JMPR participants should be requested to submit to the Secretariat copies of any written reports required by their employers on their attendance.

The Meeting fully endorsed the efforts of FAO and WHO in implementing appropriate procedures for increasing transparency in the selection of experts and for ensuring the excellence and independence of scientists who serve on scientific committees by developing ethical guidelines and revising the declaration of interests that all participants must sign.

2.8 Information required for Good Agricultural Practice

In the *FAO Manual* (FAO, 1997), paragraph 3.1.4 states the requirements for the submission of information on GAP. It emphasizes that original labels should be provided, in addition to summary information. Furthermore, the original label should be accompanied by an English translation of the relevant sections if it is printed in a language other than English.

The report of the 1997 JMPR (Annex 6, reference 80, General considerations 2.2) indicates that information on GAP is very difficult or impossible to interpret. The following requirements are re-emphasized:

- The summary should not include any information on use that is not given on the label.

- Valid copies of current labels must be provided, together with English translations of the relevant sections.
- Crops included in groups should be named individually.
- Labels reflecting current GAP should be clearly distinguished from 'proposed' labels.

In future, the specific uses of a compound will not be evaluated if the relevant labels have not been provided. To avoid unnecessary costs for the translation of labels by industry and to avoid unnecessary work for FAO panel members in evaluating excessive information, GCPF has proposed that the requirements be modified.

In future, companies should submit labels and summary information on GAP only for those uses that are adequately supported by data on residues according to FAO requirements. In deciding whether such information is available, companies should bear in mind that data from one country can be extrapolated to use in a country with comparable climatic conditions and also that the information on GAP and labels in the second country must be taken into account.

The Meeting agreed that review of irrelevant information is a burden to both Members and companies. The Meeting considered the proposal of GCPF but noted that a company may not always have a clear view of which extrapolations are valid. In such cases, the Meeting might be unable to propose an MRL for a commodity for lack of relevant GAP information, although such information exists but was not provided by the company. The Meeting therefore considered that full summary information on GAP should be submitted and that the original labels (and if necessary the translations) need be provided only for those uses that are adequately supported by residue data according to FAO requirements.

2.9 Harmonization between JECFA and JMPR

Some chemicals have dual uses as pesticides and as veterinary drugs and may therefore be evaluated by both the JMPR and the Joint FAO/WHO Expert Committee on Food Additives (JECFA). In order to ensure consistency and transparency, both JMPR and JECFA have developed data requirements and evaluation and working procedures corresponding to their needs. There are some differences in the two approaches.

Both JMPR and JECFA have noted that when such substances are used on plants they may give rise to metabolites and/or photodegradation products in plants and feed and consequently in animal commodities and that these products are not observed when the animals are treated directly with the substances as veterinary drugs. This difference may affect the definition of residues of toxicological concern, establishment of the ADI and MRLs, and estimation of dietary intake by consumers.

The Meeting noted that it has been necessary to establish different ADIs to accommodate the evaluation of a substance for use as both a pesticide and a veterinary drug when a metabolite or photodegradation product arising from application on plants is not present in animals after direct treatment. Furthermore, for substances used both on crops and on animals, different residue definitions and different MRLs have been proposed for the same chemical and the same food commodity by JMPR and JECFA.

In order to harmonize the results of the evaluation processes, the FAO panels of JECFA and JMPR held joint meetings in 1995 and 1999. The response of the JMPR to the recommendations of the 1999 meeting are outlined in the 1999 JMPR report (Annex 6, reference 86, section 2.3). One of the recommendations was that a representative of the FAO Panel (preferably the Chairperson) and the FAO Joint Secretary to JMPR and JECFA should participate in the respective meetings of JECFA and

JMPR in order to advance understanding of the processes and to identify matters for further harmonization.

In order to continue such efforts, the FAO Joint Secretary of the JMPR invited the Chairman and a member of the FAO Panel of JECFA to participate in the meeting of the FAO Panel of the 2000 JMPR. The points identified at the meeting that required harmonization between JMPR and JECFA were: definition of residues, daily food intake, relation between MRLs and ADIs in JECFA evaluations, extrapolation between animal species, recommendations for MRLs and STMR and HR values, expression of MRLs as mg/kg or µg/kg, analytical methods, description of food commodities and edible tissues, and food processing.

2.10 Establishment of the acute reference dose

The issue of the acute reference dose (RfD) was again raised by the CCPR at its thirty-second session (ALINORM 01/24). National regulatory agencies and the European Union have also addressed the issue. It is recognized that current toxicological databases are not designed for establishing acute RfDs and often do not address the end-points and timing relevant for accurate determination of an acute RfD. Therefore, except for a few compounds (primarily inhibitors of cholinesterase activity), acute RfDs have been established mainly on the basis of multiple-dose studies. They are therefore quite "conservative". Moreover, criteria to define those pesticides for which an acute RfD is unnecessary have not been established, nor has a conclusion been reached on whether the usual safety factor of 100 should always be applied.

The Meeting reaffirmed its previous conclusion that establishment of an acute RfD should be considered for all compounds, and a decision on whether to establish an acute RfD should be considered on a case-by-case basis. The Meeting concluded that the following categories of toxicological alerts would suggest the need for an acute RfD:

- lethality after administration of a single low dose orally
- developmental effects, except when they are clearly a consequence of maternal toxicity
- clinical signs, other pharmacological effects, or effects on target organs observed early in studies with repeated doses, including effects on behaviour or on the gastrointestinal, cardiovascular, or respiratory system
- acute neurotoxicity, including that due to exposure to organophosphates and carbamates
- hormonal or other biochemical alterations observed in studies with repeated doses, which might conceivably be elicited by a single dose.

When there is no toxicological alert for acute effects and it is concluded that establishment of an acute RfD is unnecessary, the basis for the decision should be clearly stated.

The Meeting emphasized that a study of toxicity with a single oral dose would be required only if one of the above alerts has been identified in standard studies and adequate no-observed-adverse-effect levels (NOAELs) cannot be established on the basis of these studies. Even if the acute RfD established by this approach is conservative, further refinement may be unnecessary, e.g. when the margin of safety is very large.

The Meeting stressed that in the design of studies to identify acute NOAELs, some flexibility should be allowed in the choice of the relevant end-points. As indicated above, the Meeting considered that such studies should not be a mandatory part of the toxicological dossier.

Acute RfDs are particularly well-suited for the derivation and application of chemical-specific adjustment factors to replace the default safety (uncertainty) factor (the report of an IPCS workshop to

be published in 2001 will address this issue; see also WHO, ?). The Meeting recommended that this issue should be discussed at a future session.

The Meeting prepared a proposed test guideline for the conduct of studies of the toxicity of single oral doses for submission to the OECD, for establishment of acute RfDs (Annex 5). The Meeting also prepared a draft guidance document for interpretation of the data generated from such studies, which is included in Annex 5.

2.11 Summaries of critical end-points

Since 1995, the Joint Meeting has included in its toxicological evaluations a table identifying the end-points relevant for setting guidance values for dietary and non-dietary exposure. The table is included to draw attention to the critical toxicological results relevant to human exposure by various routes. The format was modified in 1998 to make it consistent with the format developed by OECD, as the Meeting concluded that this format provided a clear presentation of data that highlighted the toxicological profile of the pesticide.

The Meeting has received no comments from users of the evaluations as to whether this information serves a useful purpose. Such feedback would be useful for determining whether to continue including the table in the reports and toxicological monographs. The Meeting invites comments, to be submitted to the WHO Joint Secretary of JMPR.

References

Codex Alimentarius Commission (1993) Pesticide Residues in Food, Joint FAO/WHO Food Standards Programme, Vol. 2.

Codex Committee on Pesticide Residues (1999) Report of the Thirty-first Session (ALINORM 99/24A), The Hague, para 105.

Codex Committee on Pesticide Residues (2000) Report of the Thirty-second Session (ALINORM 01/24), The Hague, para 18, 61–66.

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Environmental Protection Agency (1989)

FAO (1997) *FAO Manual on the Submission of Pesticide Residue Data for the Estimation of Maximum Residue Levels in Food and Feed*, Rome: FAO, p. 27

WHO (1990) *Principles for the Toxicological Assessment of Pesticide Residues in Food* (Environmental Health Criteria 104), Geneva

WHO (1994) *Assessing Human Health Risks of Chemicals: Derivation of Guidance Values for Health-based Exposure Limits* (Environmental Health Criteria 170), Geneva

WHO (2000) *Tobacco Company Strategies to Undermine Tobacco Control Activities at the World Health Organization, Report of the Committee of Experts on Tobacco Industry Documents, July 2000*

3. DIETARY RISK ASSESSMENT FOR PESTICIDE RESIDUES IN FOOD

3.1 Assessment of risk of long-term dietary exposure

Risks associated with long-term dietary intake were assessed for compounds for which MRLs and STMR values were considered at the present Meeting. Dietary intakes were calculated by multiplying the concentrations of residues (STMR or STMR-P values or recommended MRLs) by the average daily *per capita* consumption estimated for each commodity on the basis of the GEMS/Food diets (WHO, 1997a,b). Theoretical maximum daily intakes (TMDIs) were calculated when only recommended or existing MRls were available. IEDIs are derived only when STMR or STMR-P values are used in the calculation. Dietary intake estimates (DIEs) were calculated from combinations of recommended MRLs and STMR or STMR-P values. Codex MRLs that have been recommended by the JMPR for withdrawal were not included in the estimates.

Long-term dietary intakes are expressed as percentages of the ADI for a 60-kg person except for the GEMS/Food Far Eastern diet, in which a body weight of 55 kg is used. The estimates are summarized in Table 1. The percentages up to and including 100% are rounded to one significant figure and values above 100% to two significant figures. When the percentages for compounds for which IEDIs are calculated are greater than 100%, the information provided to the JMPR does not allow estimation that the dietary intake would be below the ADI. These compounds are identified by a footnote to the Table. The detailed calculations of long-term dietary intake are given in Annex 3.

The calculations of dietary intake can be further refined at the national level by taking into account more detailed information on food consumption, data from monitoring and surveillance, data on total diet, or reliable data on the per cent of crop treated and the per cent of crop imported.

Table 1. Summary of risk assessments of long-term dietary intake conducted by the 2000 JMPR

Code	Name	ADI (mg/kg bw)	Exposure range (% of ADI)	Type of assessment
07	Captan	0.1	0–8	IEDI
015	Chlormequat	0.05	0–3	IEDI
	Chloropham	0.03	No MRL proposed	
017	Chlorpyrifos	0.01	1–6	IEDI
021	DDT	0.01	10–32[a]	IEDI
135	Deltamethrin	0.01	40–70	TMDI
084	Dodine	0.1	0–7	TMDI
037	Fenitrothion	0.005	260–780[b]	TMDI
039	Fenthion	0.007	1–10	DIE
110	Imazalil	0.03	10–100	TMDI
049	Malathion	0.3	0	IEDI
053	Mevinphos	0.0008	All MRLs proposed for withdrawal	
58	Parathion	0.004	7–20	IEDI
59	Parathion-methyl	0.003	3–30	IEDI
63	Pyrethrins	0.04	0	IEDI
200	Pyriproxyfen	0.1	0	
65	Thiabendazole	0.1	1–9	IEDI
154	Thiodicarb	0.03	4–50	TMDI

[a] On the basis of a violation rate of 0.1% for both meat and poultry meat

[b] The information provided to JMPR precludes an estimate that the long-term dietary intake of residues would be below the ADI.

3.2 Assessment of risk of short-term dietary exposure

Risks associated with short-term dietary intake were assessed for compounds for which MRLs were recommended and STMR values estimated at the present Meeting and for which an acute RfD has been established, in commodities for which data on consumption were available. The procedures for calculating short-term intake were defined at the Geneva Consultation (WHO, 1997b) and refined in subsequent meetings (Pesticide Safety Directorate, 1998; Annex 6, reference 86, Annex V and section 2.4) and by the present Meeting, as described in section 2.1. Data on the consumption of large portions were provided by Australia, France, Japan, the Netherlands, the United Kingdom, and the USA. Data on unit weights and per cent edible portion were provided by France, the United Kingdom, and the USA. The body weights of adults and children aged 6 and under were provided by Australia, France, the Netherlands, the United Kingdom, and the USA.

International estimated short-term intake (IESTI)

Depending on the data on consumption, the IESTI for each commodity will be calculated according to the equation defined for each case described below (1, 2a, 2b, and 3). The following definitions apply to the equations:

LP	largest portion reported (eaters at the 97.5th percentile of consumption), in kg of food per day
HR	highest concentration of residue in composite sample of edible portion found in supervised trials from which the MRLs and STMR values were derived, in mg/kg
HR-P	highest concentration of residue in the processed commodity, in mg/kg, calculated by multiplying the HR in the raw commodity by the processing factor
bw	body weight (kg) provided by the country in which the LP was used
U	unit weight in edible portion, in kg, provided by the country in the region where the
trials	that gave the highest concentration of residue were carried out; calculated allowing for
the	per cent edible portion
ν	variability factor
STMR	supervised trials median residue, in mg/kg
STMR-P	supervised trials median residue in processed commodity, in mg/kg

Case 1. The concentration of residue in a sample or in a composite sample (raw or processed) reflects that in a meal-sized portion of the commodity (unit weight of the whole portion is < 25 g).

$$\text{IESTI} = \frac{LP \times (HR \text{ or } HR\text{-}P)}{bw}$$

Case 2. The meal-sized portion, as a single fruit or piece of vegetable, might have a higher concentration of residue than the composite (unit weight of the whole portion is > 25 g). The variability factors ν given below are to be applied in the equations. When sufficient data are available on residues in each unit to calculate a more realistic variability factor for a commodity, the calculated value should replace the default value:

Unit weight of whole portion is > 250 g, ν = 5
Unit weight of whole portion is 250 g, ν = 7
Unit weight of whole portion is 250 g after granular soil treatment, ν = 10
Leafy vegetables, unit weight of whole portion is 250 g, ν = 10

Case 2a. The unit weight of the whole portion is lower than that of the large portion, LP.

$$\text{IESTI} = \frac{\text{U x (HR or HR-P) x } \nu + \text{(LP--U) x (HR or HR-P)}}{\text{bw}}$$

Case 2b. The unit weight of the whole portion is higher than that of the large portion, LP.

$$\text{IESTI} = \frac{\textit{LP} \text{ x } (\textit{HR} \text{ or } \textit{HR-P}) \text{ x } \nu}{\text{bw}}$$

Case 3. Bulking or blending of a processed commodity means that the STMR-P value probably represents the highest concentration of residue.

$$\text{IESTI} = \frac{\textit{LP} \text{ x } \textit{STMR-P}}{\text{bw}}$$

A risk assessment for short-term dietary intake was conducted for each commodity–compound combination by assessing the IESTI as a percentage of the acute RfD of the compound (Table 2). If the percentage is greater than 100%, the information provided to the JMPR cannot lead to an estimate that the short-term dietary intake of the residue in that commodity would be below the acute RfD. These compound–commodity combinations are identified by a footnote to the Table .

The Meeting concluded that acute RfDs might be necessary for malathion and thiabendazole, but these have not yet been established. The IESTIs were calculated, but the risk assessment could not be finalized. The Meeting recommended that these compounds be evaluated for establishment of acute RfDs in the near future.

The Meeting concluded previously that acute RfDs are unnecessary for captan, DDT, imazalil, and pyriproxifen on the basis of a determination that each pesticide is unlikely to present a toxicological hazard after a single exposure. Therefore, as the residues are unlikely to present an acute risk to consumers, intake was not estimated.

The IESTIs and or percentage acute RfDs for the general population and for children under the age of 6 are summarized in Table 6. The percentage RfDs are rounded to one significant figure for values up to and including 100% and to two significant figures for values above 100%. The detailed calculations of short-term dietary intake are given in Annex 4.

Table 2. Summary of risk assessments of short-term dietary intake conducted by the 2000 JMPR

Code	Compound	Acute RfD (mg/kg bw)	IESTI (mg/kg bw per day)		Percentage of acute RfD	
			General population	Children	General population	Children
015	Chlormequat	0.05	Pear: 0.12 Other commodities: 0–0.035	Pear: 0.35 Other commodities: 0–0.029	Pear: 240[a] Other commodities: 0–70	Pear: 710[a] Other commodities: 0–60
	Chlopropham	0.03	No MRLs proposed			

017	Chlorpyrifos	0.1	0–0.041	0–0.77	0–40	0–80
135	Deltamethrin	0.05	No existing or proposed STMR or HR values			
087	Dinocap	0.008[b] 0.03[c]	Grape: 0.012 Other commodities: 0.00012–0.0075	Grape: 0.036 Other commodities: 0–0.019	Grape: 150 Other commodities: 1–90	Grape: 120 Other commodities: 0–60
084	Dodine	0.2	No existing or proposed STMR or HR values			
037	Fenitrothion	0.04	No existing or proposed STMR or HR values			
039	Fenthion	0.01	0.00009	0.00018	1	2
049	Malathion	May be necessary but not yet established	0.00005	0.00009		
053	Mevinphos	0.003	All MRLs proposed for withdrawal			
58	Parathion	0.01	Barley: 0.04 Other commodities: 0–0.0048	Apples: 0.014 Other commodities: 0–0.0037	Barley: 400 Other commodities: 0–50	Apples: 140 Other commodities: 0–40
59	Parathion-methyl	0.03	0–0.0075	0–0.023	0–30	0–80
063	Pyrethrins	0.2	0.00024–0.006	0.00059–0.016	0–3	0–8
65	Thiabendazole	May be necessary but not yet established	0.00014–0.29	0.00025–0.94		
154	Thiodicarb	0.04				

[a] The information provided to the JMPR precludes an estimate that the acute dietary intake of the residue in this commodity would be below the acute reference dose.

[b] For women of childbearing age

[c] For general population other than women of childbearing age

References

Pesticide Safety Directorate (1998) *Pesticide Residues Variability and Acute Dietary Risk Assessment*. York.

WHO (1997a) *Food Consumption and Exposure Assessment of Chemicals*, Report of FAO/WHO Consultation, Geneva.

WHO (1997b) *Guidelines for Predicting Dietary Intake of Pesticide Residues,* 2nd revised edition, (GEMS/Food document WHO/FSF/FOS/97.7), Geneva.

4. EVALUATION OF DATA FOR ACCEPTABLE DAILY INTAKE FOR HUMANS, MAXIMUM RESIDUE LEVELS, AND SUPERVISED TRIALS MEDIAN RESIDUE LEVELS

Note: * denotes values at or near the limit of quantification

4.1 Abamectin (177)

Definition of the residue

Abamectin was placed on the agenda of the 2000 JMPR at the request of the CCPR at its thirty-second session in 2000 for reconsideration of the residue definition for animal commodities with a view to removing avermectin B_{1b} and 8,9-*Z*-avermectin B_{1b} from the definition for residues in animal commodities.

Abamectin is used both as a pesticide and as an anthelminthic drug in animals. It was evaluated toxicologically by the Meeting in 1992 and 1994, and an ADI of 0–0.0002 mg/kg bw was established on the basis of a NOAEL of 0.12 mg/kg bw per day for toxicity in pups in a study of reproductive toxicity in rats. A safety factor of 500 was applied because of concern about the teratogenicity of the 8,9-*Z*-isomer, a photodegradation product that has been detected as a residue in plants. MRLs were recommended for commodities of cattle (edible offal, 0.05 mg/kg; meat, 0.01* mg/kg; milk, 0.005 mg/kg) and goats (edible offal, 0.1 mg/kg; meat, 0.01* mg/kg; milk, 0.005 mg/kg). The residues were defined in 1992 as the sum of avermectin B_{1a}, 8,9-*Z*-avermectin B_{1a}, and avermectin B_{1b}. The 1992 Meeting was unaware of the existence of a photoisomer of avermectin B_{1b}.

In the analytical method, avermectin B_{1a} is derivatized to a fluorescent compound for analysis by HPLC. As avermectin B_{1a} and its 8,9-*Z*-isomer form an identical fluorescent derivative, they are not separated or distinguished in the analysis for residues. The method gives a single HPLC peak for the sum of avermectin B_{1a} and its 8,9-*Z*-isomer. Avermectin B_{1b} and its photoisomer behave analogously to produce a second, but smaller, peak. In 1992, the LOQ (known at that time as the limit of determination) for meat was 0.01 mg/kg.

The use of abamectin as a veterinary drug was considered by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) at its forty-fifth meeting, in 1995. The Committee had intended to rely on the toxicological evaluation of the 1994 JMPR, but, on reviewing the data on residues found when abamectin is used as a veterinary drug, it learned that the 8,9-*Z*-isomer is not present in animal tissues and that the major residue in cattle liver and fat is avermectin B_{1a}, accounting for 50% of the total residue 7 days after treatment. 24-Hydroxymethyl-B_{1a} is a major part of a polar residue fraction that accounts for 22% of the total residue in liver 14 days after treatment and a major part of a fraction that accounts for 51% of the total residue in fat 21 days after treatment. Avermectin B_{1b}, which represents about 5% of the total residue in liver and fat 7 days after treatment, is a minor residue. Therefore, JECFA concluded that avermectin B_{1a} is a suitable marker residue and recommended that consultations be held between representatives of JECFA and JMPR. At that meeting, held in September 1995, it was recognized that consideration should be given to establishing different ADIs for abamectin when it is used as a pesticide and as a veterinary drug.

As a consequence, the 1995 JMPR agreed that the ADI of 0–0.0002 mg/kg bw was not appropriate for abamectin residues that do not contain the 8,9-*Z*-isomer, and it allocated an ADI of 0–0.001 mg/kg bw to abamectin, on the basis of a NOAEL of 0.12 mg/kg bw per day observed in the study of reproductive toxicity in rats, with a safety factor of 100.

JECFA at its forty-seventh meeting, in 1996, established MRLs of 0.1 mg/kg for cattle liver and fat tissue and 0.05 mg/kg for cattle kidney. The marker residue was avermectin B_{1a}. A validated analytical method (HPLC with fluorescence detection for avermectin B_{1a}) is available. The residue defined for estimation of dietary intake is the total residue.

New toxicological data were evaluated by the JMPR in 1997. In view of the finding that rats are hypersusceptible postnatally, the Meeting agreed to reduce the interspecies safety factor in establishing an ADI. A safety factor of 50 was therefore applied to the NOAEL of 0.12 mg/kg bw in the multigeneration study in rats, which is corroborated by a NOEL of 0.24 mg/kg bw per day in a 1-year study in dogs, with a safety factor of 100. It was considered appropriate to establish a single ADI for abamectin and its 8,9-*Z*-isomer, since the potential teratogenicity of the isomer had been satisfactorily explained. An ADI of 0–0.002 mg/kg bw was established for the sum of abamectin and its 8,9-*Z*-isomer. In order to harmonize the MRLs with those proposed by JECFA, the Meeting suggested that the MRLs be modified as follows: cattle edible offal to be removed; cattle liver and cattle fat, 0.1 mg/kg; and cattle kidney, 0.05 mg/kg. These numerical values are the same as those proposed by JECFA, but the residue definition differs by including avermectin B_{1a}, avermectin B_{1b}, 8,9-*Z*-avermectin B_{1a}, and 8,9-*Z*-avermectin B_{1b}. The proposed MRLs for goat commodities remained unchanged.

The Meeting noted the large margin of safety between the estimated dietary intake of residues resulting from the accepted uses and the newly established ADI and concluded that the residue definition is not a matter of concern to public health but a question of analytical method and national enforcement measures for compliance with MRLs.

At a meeting to facilitate harmonization between JECFA and JMPR, held on 1–2 February 1999, the different definitions of the CCPR and the CCRVDF for residues of abamectin were noted, and the CCRVDF and JECFA were asked to consider expanding their residue definitions to include other isomers, such as the photodegradation isomer of avermectin B1a.

JECFA at its fifty-fourth meeting, in February 2000, carefully considered the toxicological and chemical assessments of abamectin made by JMPR and concluded that inclusion of the photodegradation isomer in the residue definition would not be consistent with the assessment by JECFA of abamectin as a veterinary drug. Inclusion of other possible residues of abamectin will be reviewed at a future JECFA meeting.

The CCPR at its thirty-second session, in May 2000, noted that the CCRVDF at its 12th meeting had retained all draft MRLs at step 7 because of the different residue definitions for animal products proposed by JECFA and JMPR. The CCPR therefore decided to refer the question of the residue definition for animal products to the 2000 JMPR with the suggestion that avermectin B_{1b} and 8,9-*Z*-avermectin B_{1b} be removed from the definition for the sake of harmonization. In the meantime, the CCPR returned all draft MRLs for animal commodities to step 6 and advanced all draft MRLs for plant commodities to Step 8.

The residue definitions and MRLs currently proposed by JMPR and JECFA are:

Residue definition 1996: B_{1a}	MRL (mg/kg) JMPR 1992: Sum of avermectin B_{1a}, B_{1b}, and 8,9-*Z*-avermectin B_{1a}	JMPR 1997: Sum of avermectin B_{1a}, B_{1b}, 8,9-*Z*-avermectin B_{1a} and B_{1b}	JECFA Avermectin
Cattle, edible offal	0.1	W	–
Cattle, meat	0.01*		–
Cattle, milk	0.005		–
Cattle, liver		0.1	0.1
Cattle, fat		0.1	0.1
Cattle, kidney		0.05	0.05
Goat, edible offal	0.1		–
Goat, meat	0.01*		–
Goat, milk	0.005		

W, the previous recommendation was withdrawn

Recommendations

The Meeting proposed to continue to harmonize the MRLs of JMPR and JECFA for abamectin in animal commodities and recommended that:

- the numerical MRL values of 0.1 mg/kg for cattle liver and cattle fat and 0.05 mg/kg for cattle kidney be maintained as proposed by the 1997 JMPR
- the residue definition for compliance with the MRL be simplified to include only avermectin B_{1a} and 8,9-*Z*-avermectin B_{1a} (i.e. to eliminate avermectin B_{1b} and 8,9-*Z*-avermectin B_{1b} from the residue definition)

The definition of the residue in animal commodities for compliance with the MRL is the sum of avermectin B_{1a}, avermectin B_{1b}, and 8,9-*Z*-avermectin B_{1a}, whereas the definition of the residue in plant commodities and for estimation of dietary intake is the sum of avermectin B_{1a}, avermectin B_{1b}, 8,9-*Z*-avermectin B_{1a}, and 8,9-*Z*-avermectin B_{1b}.

It is further recommended that JMPR and JECFA continue to organize joint meetings in order to make common recommendations for MRLs in terms of residue definitions, marker residues, and descriptions of commodities and tissues to allow progressive harmonization of the recommendations of JMPR and JECFA for substances, such as abamectin, that are used as pesticides and veterinary drugs.

Codex number	Commodity	MRL (mg/kg)[a]
MO 1281	Cattle liver	0.1
MF 0812	Cattle fat	0.1
MO 1289	Cattle kidney	0.05
MM 0812	Cattle meat	0.01*
ML 0812	Cattle milk	0.005
MO 0814	Goat edible offal	0.1
MM 0814	Goat meat	0.01*
ML 0814	Goat milk	0.005

[a] The numerical values remain unchanged but the residue definitions are revised.

4.2 Captan (07)

Residue and analytical aspects

Captan was first evaluated in 1965. It was listed by the 1995 CCPR (ALINORM 95/24 A) for periodic re-evaluation, and the 1997 CCPR scheduled it for consideration by the FAO Panel of the 1998 JMPR (ALINORM 97/24 A). As the rights on this compound were being shifted from one company to another, a request was made that re-evaluation of captan be deferred until 2000. The Meeting received information on the physicochemical properties, metabolism, environmental fate, analytical methods, stability under storage, registered uses, residues found in supervised trials, and processing.

Metabolism

Captan is susceptible to cleavage of the N–S bond to produce 1,2,3,6-tetrahydrophthalimide (THPI) and derivatives of the tetrachloromethylthio side-chain. The Meeting received reports of studies of the distribution and metabolism of captan in animals and plants in which captan was radiolabelled at the cyclohexene ring, the indole ring, or the carbon of the trichloromethylthio side-chain.

Animals and birds

In a material balance study, [trichloromethyl-^{14}C]captan was administered to lactating goats by gelatine capsule (at a dose equivalent to 55 ppm) for 2 days, and the animals were slaughtered 16 h after the last dose. Most of the radiolabel was recovered in the gastrointestinal tract (20%) and as expired CO_2 (43%) and most of the remainder in urine (8%), faeces (4.6%), and milk (0.2%). When a lactating goat was given [trichloromethyl-^{14}C]captan at a dose equivalent to 50 ppm for 7 days, 36% of the radiolabel was recovered in the excreta. The concentration of total radiolabelled residues in milk plateaued at 2.2 mg/kg (expressed as captan) on days 4–5. The highest concentrations were observed in kidney (4.4 mg/kg) and liver (4.7 mg/kg) (as captan). The low recovery of the administered dose is probably due to bacterial conversion of $^{14}CO_2$ to methane in the rumen.

The radiolabel in tissues at sacrifice accounted for 1.3% of a dose of [trichloromethyl-^{14}C]captan administered to a lactating goat orally at 1.4 mg/kg bw per day for 3 days. The highest concentrations were found in liver (2.0 mg/kg) and kidney (1.6 mg/kg) (as captan). Most of the radiolabel in tissues and milk was incorporated into natural products.

When a lactating goat was given a capsule containing [carbonyl-^{14}C]captan at 1.4 mg/kg bw per day three times daily (equivalent to 50 ppm), the major metabolites in urine were *cis*- or *trans*-3-hydroxy-1,2,6-trihydrophthalimide, *cis*- or *trans*-5-hydroxy-1,2,6-trihydrophthalimide, and 4,5-dihydroxyhexahydrophthalimide. The major metabolites in tissues and milk were THPI, *cis*- or *trans*-3-hydroxy-1,2,6-trihydrophthalimide, and *cis*- or *trans*-5-hydroxy-1,2,6-trihydrophthalimide. The concentrations of total radioactive residues (in rank order) were 2.3 mg/kg in kidney, 1.7 mg/kg in liver, 0.66 mg/kg in muscle, and 0.36 mg/kg in fat, as captan.

More than 88% of a dose of [trichloromethyl-^{14}C]captan administered to a hen by capsule for 2 days at a rate equivalent to 10 ppm was recovered in excreta and as $^{14}CO_2$. Only 2.8% of the dose was recovered in the carcass.

When hens were dosed orally with [trichloromethyl-^{14}C]captan at a nominal rate equivalent to 10 ppm for 10 days, the concentrations of radiolabelled residues in eggs plateaued by day 8 of dosing. The concentrations were highest in kidney, liver, and egg yolk. Much of the radiolabelled residue was incorporated into natural products.

When a group of laying hens was dosed orally with [cyclohexene-^{14}C]captan at a nominal rate equivalent to 10 ppm for 10, the concentrations of radiolabelled residues in eggs plateaued 2–4 days after the start of dosing. Most of the dose was excreted. The radiolabel in tissues and eggs represented

3.2% of the administered dose. The major metabolites identified in tissues and eggs were THPI, *cis*- or *trans*-3-hydroxy-1,2,6-trihydrophthalimide, *cis*- or *trans*-5-hydroxy-1,2,6-trihydrophthalimide, THPI expoxide, *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid, and 4,5-dihydroxyhexahydrophthalimide.

The studies of metabolism show that captan is rapidly degraded in goats and hens and is not detectable in tissues, milk, or eggs. The N–S bond is cleaved to form THPI and derivatives of the trichloromethylthio side-chain. THPI undergoes a variety of oxidations and hydroxylations to yield THPI epoxide, 4,5-dihydroxyhexa-hydrophthalimide, *cis*- or *trans*-3-hydroxy-1,2,6-trihydrophthalimide, *cis*- or *trans*-5-hydroxy-1,2,6-trihydrophthalimide, and *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid as the major metabolites. The tetrachloromethylthio derivatives are metabolized with incorporation of the trichloromethyl carbon into natural products, including CO_2 and CH_4.

Plants

When lettuce and tomato plants were treated four times with [trichloromethyl-^{14}C]-captan or [cyclohexene-^{14}C]captan at 4.5 kg ai/ha at 7-day intervals, most of the radiolabel was found in the leaves and fruit of tomatoes and the leaves of lettuce 3 h after the last spray.

When tomatoes were treated with [cyclohexene-^{14}C]captan, unextractable residues represented less than 9% of the total radiolabel in all components except tomato pulp, in which unextractable residues represented 42% of the total radiolabel. When tomato pulp was fractionated, 71% of the radiolabel was associated with carbohydrates, 18% with amino acids, and 3% with lignins.

With both labels, most of the residue remained on the surface of the plant or fruit as unmetabolized captan. In the plants, captan was metabolized to THPI, which undergoes further transformation.

Most the radiolabel in field-grown Golden Delicious apples on trees treated with [carbonyl-^{14}C]captan and harvested 3 h and 20 days after treatment was located on the surface of the fruit and was present as captan. Residues of THPI and *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid represented 3.3–7.6% and 0.4–2.4% of the radioactive residue, respectively. The concentrations of residues in apple peel and pulp were low, captan representing 46 and 15%, respectively, of the radiolabel. The main metabolites in peel and pulp were THPI and *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid.

In apples, tomatoes, and lettuce, most residue was present on the surface of the leaves and fruit, mainly as unchanged captan. Metabolism in these plants included cleavage of the thio–indole bond with incorporation of the carbon of the tetrachloromethylthio side-chain into natural products. The other major product after cleavage, THPI, is further metabolized to *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid and THPI expoxide. Captan is also oxidized to captan epoxide, which may undergo hydrolysis to form THPI epoxide.

Environmental fate

Confined rotational crops

In a study of confined crop rotation, beet, lettuce, and wheat seeds were planted in soil treated with [cyclohexene-^{14}C]captan or [trichloromethyl-^{14}C]captan 34 and 88 days after treatment and grown to maturity. Little radiolabel was found in the crops at harvest. The concentrations of radiolabelled residues in immature plants were highest in the leaves of lettuce and beet. The concentrations in crops planted 88 days after application of captan to the soil were lower than those in crops planted 34 days

after application. No residues of captan were detected. Most of the residue consisted of THPI and a variety of more polar metabolites, the most significant being *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid and 4,5-dihydroxyhexahydrophthalimide. The Meeting concluded that the concentrations of residues of captan inadvertently introduced into rotational crops would not be significant and that the carryover of captan under field conditions would be < 0.01 mg/kg, a typical lower limit of quantitation (LOQ).

Degradation in soil

The aerobic and anaerobic metabolism of [trichloromethyl-^{14}C]captan was studied on sandy loam soils. Under aerobic conditions, most of the radiolabel was recovered as $^{14}CO_2$. The calculated degradation half-time of [trichloromethyl-^{14}C]captan was 1–3 days at 25 °C. Under aerobic conditions in sterile soil, 75% of the radiolabel was recovered as $^{14}CO_2$ within 90 days of incubation. When non-sterile soil was used, 100% of the radiolabel was recovered as $^{14}CO_2$ within 14 days of incubation. The radiolabel recovered as $^{14}CO_2$ after aerobic incubation at 25 °C of [carbonyl-^{14}C]-captan on loamy sand represented 20% by 7 days and reached 94% by 244 days of incubation. No captan was detected after 7 days of anaerobic incubation of [carbonyl-^{14}C]captan on loamy sand. Less than 9% of the radiolabel was recovered as $^{14}CO_2$ after 9 months of incubation. The major metabolites identified were THPI, *cis*-6-cyano-3-cyclohexenecarboxylic acid, *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid, and *cis*-4-cyclohexene1.2-dicarboxylic acid. The half-time for aerobic degradation of THPI at 20 °C in the dark was 5–6 days in loamy sand or sandy loam and 20 days in sand. The half-times for aerobic degradation of *cis*-4-cyclohexene1.2-dicarboxylic acid were 4–5 days in loamy sand or sandy loam and 7 days in sand.

Captan is not susceptible to photolytic degradation, as the loss after irradiation of [trichloromethyl-^{14}C]captan or [cyclohexene-^{14}C]captan on sandy loam soil was minor when compared with hydrolysis and metabolic degradation.

Studies of the dissipation of captan in loamy sand, sand, clay, loam, and silt loam soils showed that it did not migrate below the top 15 cm of soil, except in a single sample of loamy sand (strawberry plot). The half-times for captan in the 0–7.5-cm soil horizon were 14 days in an apple orchard, 2.5 days in a strawberry plot, 24 days in a grape plot, 4 days in a cantaloupe plot, and 3–6 days in tomato plots.

Captan is not amenable to the absorption or desorption from soil or water systems owing to its rapid hydrolysis. The degradation of captan in soil–water mixtures was dependent on pH, being most rapid at pH 7, the highest pH studied. The only degradate detected was THPI. The presence of soil in the test solutions resulted in an increased rate of degradation.

In studies of leaching in three soil types, captan was not readily leached, none being found below the 0–5-cm horizon. The degradation half-times for captan in aged soil samples were 10–35 days.

Fate in water and sediment systems

The half-time of captan in two non-sterile water and sediment systems was < 24 h, no captan being detected after 24 h of incubation. Captan is rapidly hydrolysed to THPI. Other metabolites identified after the incubation were *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid, *cis*-4-cyclohexene-1,2-dicarboxy-lic acid, and THPI epoxide. The metabolites were degraded, such that none could be detected after 59 days of incubation. Negligible amounts of $^{14}CO_2$ evolved in the sterile systems. Most of the radiolabel present after 90 days of incubation was found in THPI. There was no significant volatilization of captan from soil.

Methods of analysis

Adequate methods have been developed for the analysis of residues of captan and THPI on crops and for THPI and the hydroxylated metabolites *cis*- and *trans*-3-hydroxy-1,2,6-trihydrophthalimide and *cis*- and *trans*-5-hydroxy-1,2,6-trihydrophthalimide in animal commodities. The methods typically involve maceration of the sample with a solvent, which is usually ethyl acetate or acetone. As captan is readily hydrolysed at high pH, a small quantity of phosphoric acid is often added at the extraction step in order to lower the pH. Different procedures are required for the clean-up of captan and THPI: Extracts of captan are cleaned-up on a silica column, while THPI must be partitioned with basic aqueous buffer and then with dichloromethane. The final extracts are analysed on a gas chromatograph equipped with an electron capture detector for captan and a thermionic detector for THPI. Typical LOQs are 0.01 mg/kg for captan and 0.02 mg/kg for THPI. The hydroxylated metabolites 3-hydroxy- and *cis*- or *trans*-5-hydroxy-1,2,6-trihydrophthalimide must be silylated before determination by gas chromatography. Extensive data on recovery were presented for the most common methods.

Stability of residues in stored samples

The possibility that captan on agricultural commodities might be hydrolysed must be considered when conducting analyses. Samples for analysis should be stored whole, and the extraction step should be completed as soon as possible after maceration. The stability of captan and THPI during frozen storage of field and fortified samples of almonds, almond nuts (whole, coarsely ground), apples, apple juice, apple sauce, beet tops, cherries, corn grain, cucumbers, dry grape pomace, lettuce, maize grain (whole, coarsely ground), melons, potato tubers, raisins, soya bean forage, soya beans, spinach (leaves, coarsely chopped, finely chopped), strawberries, sugar-beet tops, tomatoes, tomato pomace, tomato sauce, and wheat forage were determined.

The concentrations of residues of captan represented more than 70% of the initial concentration for at least 15 months in apple juice and soya bean forage; 14 months in strawberries; 13 months in apples; 12 months in cherries; 10 months in raisins; 9 months in whole almond nuts, apple sauce, dry grape pomace, potatoes, tomatoes, dry tomato pomace, and tomato sauce; and 6 months in sugar-beet tops. Generally, when captan was degraded the concentration of THPI increased concomitantly. THPI was stable for at least 14 months when stored frozen in a variety of matrices.

Captan residues were more stable when stored in whole commodities than in homogenized samples. Maceration may increase exposure of captan residues to plant enzymes and water. As the main route of decomposition appears to be hydrolysis to THPI, the finding of lower concentrations of THPI residues than of captan residues is a good indication that the residue is stable in storage. With the exception of homogenized cucumbers (and presumably other cucurbits), the stability of captan in the commodities for which maximum residue levels are recommended is acceptable. The stability of captan in cucurbits might be acceptable if the samples are stored whole.

Captan is not expected to be detected in milk, eggs, or animal tissues. THPI, *cis*- and *trans*-3-hydroxy-1,2,6-trihydrophthalimide, and *cis*- and *trans*-5-hydroxy-1,2,6-trihydrophthalimide were stable in frozen fortified bovine milk and tissue samples for 3.2–3.7 years.

Definition of the residue

Captan is the major component of the residue in plants but may be hydrolysed to THPI during preparation of samples for analysis, frozen storage (especially of homogenized samples), and processing of the raw agricultural commodity. A separate analysis would be required if THPI were included in the residue definition, but it usually represents only a minor part of the residue and its

inclusion in the residue definition for captan would make little difference. On the basis of the metabolism of captan in plants, the conclusions of the 1995 JMPR on the toxicity of residues of captan, and the available analytical methods, the Meeting concluded that the residue for compliance with MRLs and for estimation of dietary intake should continue to be captan.

Results of supervised trials

Captan is registered for use as a fungicide with foliar, soil, and post-harvest applications. The results of supervised trials were reported for citrus (oranges, mandarins, lemons, grapefruit), apples, pears, cherries, peaches, nectarines, plums, apricots, blueberries, strawberries, grapes, raspberries, cucumbers, melons, tomatoes, potatoes, radishes, chives, and almonds.

Trials with *mandarin* were presented from Japan, but the application rates were exaggerated and did not comply with GAP; furthermore, residues in pulp and peel were analysed separately. Although data were made available for *lemon* and *grapefruit* in the USA, the data were not evaluated as there was no matching GAP value.

The results of trials with *orange* in Brazil and Spain were available. In four trials in Brazil that complied with GAP (0.11–0.12 kg ai/hl; PHI, 7 days), the concentrations of residues were 0.06, 0.10, 0.17, and 0.34 mg/kg. THPI was not detected in the two trials in which it was measured (< 0.05 mg/kg). The concentrations of residues of captan in four trials conducted in Spain according to GAP (0.15–0.25 kg ai/hl; PHI, 10 days) were 0.4, 1.0, 2.1, and 2.7 mg/kg. No residues of THPI were detected (< 0.05 mg/kg). The Meeting concluded that the results of the studies in Brazil and Spain could not be combined for the purposes of estimating a maximum residue level as they represented two different populations. A trial reported from the USA was not conducted according to GAP and was not considered further. Insufficient information was available to recommend a maximum residue level for oranges.

Supervised field trials on *apple* were reported from Argentina, Australia, Brazil, Canada, Germany, Hungary, Japan, the Netherlands, South Africa, the United Kingdom, and the USA. Trials in Chile, France, Israel, and Portugal did not correspond to GAP in those countries and were not evaluated.

The registered use pattern in Argentina is 0.12 kg ai/hl with a 14-day PHI. The concentration of residues in apples in a single trial with a spray concentration of 0.16 kg ai/hl was 0.0005 mg/kg.

In Australia, seven sprays at 0.13 kg ai/hl were used, and apples were sampled 7 days after the last spray. The GAP value in Australia is sufficiently close: five applications of 0.1 kg ai/hl with a 7-day PHI. The concentration of captan was 3.7 mg/kg. THPI was not measured.

In the six trials in Brazil, apples were sprayed 10–11 times at 0.12 kg ai/hl. The GAP value is 0.11–0.12 kg ai/hl with a 1-day PHI. The concentrations of captan residues after 1 were 0.44, 0.68, 1.0, 1.4, 2.5, and 4.1 mg/kg and those of THPI were 0.11, 0.12, 0.18, 0.18, 0.38, and 0.55 mg/kg.

Eight trials on apples in Canada, in which the conditions corresponded to the GAP value (3 kg ai/ha; PHI, 7 days) resulted in concentrations of captan of 2.8, 2.9, 2.9, 3.2, 3.9, 4.2, 4.5, and 4.5 mg/kg and residues of THPI of < 0.05, < 0.05, 0.05, 0.05, 0.05, 0.06, 0.07, and 0.08 mg/kg.

The concentrations of captan in three German trials conducted according to GAP (0.1 kg ai/hl; PHI, 21 days) were 1.0, 1.1, and 3.0 mg/kg.

In a single trial in Hungary that complied with its GAP (1–1.5 kg ai/ha or 0.1–0.15 kg ai/hl; PHI, 10 days), the concentration of residues of captan was 1.5 mg/kg.

In Japan, captan is registered for use on apples at 2–8 kg ai/ha or 0.07–0.13 kg ai/hl with harvesting 14 days after the last spray. The concentrations of residues in five trials were 1.3, 2.1, 3.8, 4.6, and 7.2 mg/kg.

The GAP value in the Netherlands is 0.05–0.21 kg ai/hl with a PHI of 7 days when application is at 0.06 kg ai/hl and 21 days when the application rate exceeds 0.1 kg ai/hl. The concentrations of residues of captan in six trials were 0.26, 0.55, 0.77, 0.84, and 1.0 (2 trials) mg/kg, and those of THPI residues were 0.11 (2 trials), 0.14, 0.19, 0.22, and 0.23 mg/kg.

The application rate in two trials conducted in South Africa was sufficiently close to the GAP value in that country (0.08–0.1 kg ai/hl; PHI, 14 days). The concentrations of residues in apples treated twice at 0.08 kg ai/hl with a 16-day PHI were 2.0 and 3.6 mg/kg, while that of THPI was 0.11 mg/kg for both trials.

The GAP value in the United Kingdom is 2.7 kg ai/ha with a PHI of 14 days. In 15 trials in which apples were given 3–16 applications at 2.7–2.9 kg ai/ha with a PHI of 12–14 days, the concentrations of captan were 0.5, 0.72, 0.91, 1.0, 1.2, 1.4, 2.0, 2.2, 2.4, 2.4, 2.6, 3.1, 3.7, 3.9, and 4.2 mg/kg. Those of THPI residues were < 0.05 (3 trials), 0.07 (2 trials), 0.08, 0.09, 0.10, 0.11, 0.12, 0.14, 0.15, 0.2 (2 trials), and 0.36 mg/kg.

Two trials in the USA met GAP in that country, which includes both pre-harvest application (2.2–4.5 kg ai/ha; PHI, 0 day) and post-harvest application (dipping at 1.5 g ai/l; withholding interval, 0 day). After eight foliar sprays at 4.5 kg ai/ha and post-harvest dipping at 1.5 g ai/l, the concentrations of residues of captan were 5.9 and 7.7 mg/kg, and those of THPI were 0.09 and 0.35 mg/kg. Post-harvest dipping alone resulted in concentrations of similar magnitude: 2.9, 3.3, 4.0, and 7.8 mg/kg. The concentrations of THPI residues were 0.12, 0.10, 0.09, and 0.08 mg/kg in the same trials. The residues of captan after pre-harvest application alone at 4.5 kg ai/ha in nine trials were 0.86, 1.4, 1.5, 2.8, 3.9, 4.7, 4.9, 5.2, and 5.5 mg/kg, and those of THPI were < 0.05, 0.07, 0.05, < 0.05, < 0.05, 0.10, 0.13, 0.76, and 0.21 mg/kg 0 days after the last spray.

The Meeting concluded that the results of trials of captan in apples by foliar and post-harvest applications should not be combined for the purposes of estimating a maximum residue level or STMR value, as they represent different residue populations. Rather, the results of trials of post-harvest application, the critical use pattern, should be used. The concentrations of residues of captan in apples in the six post-harvest trials in the USA, in rank order (median in italics), were 2.9, 3.3, ***4.0***, ***5.9***, 7.7, and 7.8 mg/kg. The Meeting decided to combine the data on apples with that on pears (see below) to estimate a maximum residue level for pome fruit. The STMR and HR values for captan in apples were estimated to be 4.95 and 7.8 mg/kg, respectively.

Supervised trials on *pear* conducted according to GAP were provided from Australia, Italy, Japan, the United Kingdom, and the USA. Trials in Chile, Germany, and South Africa did not correspond to GAP in those countries and were not evaluated.

The concentration of captan residues in a single trial in Australia after five applications of 0.13 kg ai/hl was 2.5 mg/kg 6 days after the last spray. The GAP value in Australia is five applications of 0.1 kg ai/hl with a PHI of 7 days. THPI residues were not measured.

In 12 trials in Italy, pears were given six to eight applications of 0.13 kg ai/hl with a PHI of 14 days. This rate compares well with the Italian GAP value of 0.13–0.16 kg ai/hl and a PHI of 15 days. The concentrations of residues of captan 14 days after the last spray were 0.59, 0.68, 0.72, 0.81, 1.1, 1.2, 1.2, 1.3, 1.6, 1.9, 2.0, and 2.0 mg/kg. THPI residues were not determined.

The registered application rate in Japan is seven sprays at 0.08–0.13 kg ai/hl (2.4–8 kg ai/ha) with a 7-day PHI. In six trials, pears were treated with five to nine applications of 0.13 kg ai/hl. Seven days after the last spray, the concentrations of captan were 0.50, 0.77, 0.99, 2.3, and 2.6 (2 trials) mg/kg. THPI residues were not measured.

The results of five trials were provided by the United Kingdom in which treatment comprised eight to 10 sprays at 2.7 kg ai/ha and sampling 12–14 days after the last spray. The GAP value in that country is 12 sprays at 2.7 kg ai/ha with a 14-day PHI. The concentrations of residues of captan were 1.2, 1.7, 1.9, 2.0, and 2.6 mg/kg, and those of THPI were < 0.05, < 0.05, < 0.05, 0.08, and 0.11 mg/kg.

In the USA, captan is registered for post-harvest dipping at 1.5 g ai/l. The concentrations of residues of captan in pears dipped at 1.5 g ai/l were 11 and 4.7 mg/kg, and those of THPI were 0.47 and 0.07 mg/kg, respectively.

The Meeting considered that the post-harvest trials in the USA represent a different population from that in the other trials and that the results should not be combined for the purposes of estimating a maximum residue level or STMR value. However, it considered that similar residues would occur after post-harvest dipping of apples and pears and that the results for pears could be combined with those for apples to estimate a maximum residue level and STMR value for pome fruit. The concentrations of residues of captan in apples and pears in the eight trials of post-harvest treatment, in rank order, were 2.9, 3.3, 4.0, ***4.7***, ***5.9***, 7.7, 7.8, and 11 mg/kg. The Meeting estimated a maximum residue level of 15 mg/kg, a STMR value of 5.3 mg/kg, and a HR value for captan in pome fruit of 11 mg/kg. The estimated maximum residue level replaces the current recommendations of 20 mg/kg for apples and 10 mg/kg for pears.

Supervised trials on *cherry* were provided from Canada, Germany, Japan, and the USA. A trial in Belgium did not correspond to GAP in that country and was not evaluated.

In five trials in Canada approximating GAP (3–3.6 kg ai/ha; PHI, 2 days for sweet cherries and 5 days for sour cherries), the concentrations of residues of captan were 5.0 and 13 mg/kg in sweet cherries and 4.9, 9.7, and 13 mg/kg in sour cherries.

Two trials in Germany were evaluated on the basis of the Belgium GAP (spray concentration, 0.12 kg ai/hl; PHI, 4 days), as details of GAP in Germany were not provided. The concentrations of residues of captan were 1.9 and 4.0 mg/kg 3 days after the last spray.

When captan was applied according to GAP in Japan (five sprays at 3–6 kg ai/ha or 0.1 kg ai/hl; PHI, 14 days), the concentrations of residues of captan in two trials were 0.58 and 1.3 mg/kg. Those in 12 trials of treatment with four to five sprays at 5.6–7 kg ai/ha (0.08–0.1 kg ai/hl) were 0.66, 0.69, 0.77, 0.78, 1.2, 1.3, 1.5 (3 trials), 1.7, 2.2, and 2.3 mg/kg at a PHI of 14 days.

In the USA, captan is registered for both pre-harvest use (1.1–2.2 kg ai/ha; PHI, 0 days) and post-harvest use (1.5 g ai/l). In two trials in which cherries were treated before harvest with seven sprays at 2.2 kg ai/ha and after harvest at 1.5 g ai/l, the concentrations of residues of captan were 23 and 35 mg/kg and those of THPI were 0.34 and 0.45 mg/kg. When captan was used as a post-harvest dip only in two trials, the concentrations of captan were 14 and 15 mg/kg and those of THPI were 0.23 and 0.30 mg/kg. Pre-harvest use of captan in 12 trials of six to seven sprays at 1.7–2.2 kg ai/ha resulted in residue concentrations of 2.4, 2.8, 4.3, 5.5, 11, 12, 14 (2 trials), 19, 20 (2 trials), and 21 mg/kg. In the trials in which THPI residues were measured, the concentrations were 0.13, 0.17, 0.18, and 0.24 mg/kg.

The Meeting concluded that the residues of captan in cherries in the post-harvest trials in the USA and in the trials in Japan (indoor and outdoor) represented different populations from those in the other trials, and the results ould not be combined for the purposes of estimating a maximum residue level or STMR value. The concentrations of residues of captan in cherries in the remaining 19 trials, in rank order, were 1.9, 2.4, 2.8, 4.0, 4.3, 4.9, 5.0, 5.5, 9.7, ***11***, 12, 13 (2 trials), 14 (2 trials), 19, 20 (2 trials), and 21 mg/kg. The Meeting estimated a maximum residue level of 25 mg/kg, a STMR value of 11 mg/kg, and a HR value for captan in cherries (whole fruit basis) of 21 mg/kg. The estimated maximum residue level replaces the current recommendation of 40 mg/kg for cherries.

Supervised trials on *plum* conducted according to GAP were provided from Greece, Japan, Portugal, Spain, and the USA. Trials from Chile did not correspond to GAP in that country and were not evaluated.

The concentration of captan in a trial conducted according the GAP value in Greece for stone fruit (0.13 kg ai/hl; PHI, 20 days) was 0.13 mg/kg, and that of THPI was 0.07 mg/kg.

In Japan, captan is registered for use at 2.4–8 kg ai/ha (0.08–0.13 kg ai/hl) on plums, with the last application at least 14 days before harvest. The concentrations of residues of captan in plums in four trials that complied with GAP were 0.95, 1.8, and 3.0 (2 trials) mg/kg.

The concentration of captan in a trial conducted according GAP in Portugal (0.15–0.2 kg ai/hl; PHI, 7 days) was 6.7 mg/kg, and that of THPI was 0.67 mg/kg.

In two trials conducted according to the GAP value in Spain for stone fruit (0.13–0.15 kg ai/ha; PHI, 10 days), the concentrations of captan were 0.67 and 0.85 mg/kg, and those of THPI were 0.13 and 0.18 mg/kg.

Captan is registered in the USA for use on plums at 2.2–3.4 kg ai/ha with a PHI of 0 days. The concentrations of captan in four trials approximating GAP were 0.45, 0.60, 5.6, and 7.9 mg/kg, and the corresponding values for THPI residues were < 0.05 mg/kg, although this compound was not measured in the trial in which 7.9 mg/kg of captan were found.

The concentrations of residues of captan in plums in the 12 trials, in rank order, were 0.13, 0.45, 0.60, 0.67, 0.85, ***0.95***, ***1.8***, 3.0 (2 trials), 5.6, 6.7, and 7.9 mg/kg. The Meeting estimated a maximum residue level of 10 mg/kg, a STMR value of 1.4 mg/kg, and a HR value for captan in plums (whole fruit basis, including prunes) of 7.9 mg/kg. The estimated maximum residue level replaces the current recommendation of 5 mg/kg for plums including prunes.

The concentrations of captan in *apricot* in four trials in the USA that complied with GAP (1.7–2.7 kg ai/ha; PHI, 0 day) were 3.3, 4.5, 6.0, and 6.8 mg/kg, and those of THPI were < 0.05–0.21 mg/kg. There was insufficient information to recommend a maximum residue level for apricots.

Supervised trials on *nectarine* conducted according to GAP were provided from Greece and Spain. Trials from Chile and the USA did not correspond to the maximum GAP values in those countries and were not evaluated.

The concentrations of captan in two trials conducted according to the GAP in Greece for stone fruit (0.13 kg ai/hl; PHI, 20 days**)** were 0.90 and 1.5 mg/kg, and those of residues of THPI were 0.19 and 0.22 mg/kg.

In two trials conducted according to the GAP in Spain for stone fruit (0.13–0.15 kg ai/ha; PHI, 10 days), the concentrations of captan were 1.3 and 1.8 mg/kg and those of THPI were 0.17 and 0.21 mg/kg.

An inadequate number of trials of use of captan on nectarines was available to set a maximum residue level, but the Meeting agreed that the results of trials in comparable countries on peaches and nectarines treated at the same rates and harvested at the same PHI could be combined for the purposes of estimating a maximum residue level and STMR value. Application of captan to *peaches* in seven trials in Italy at rates that corresponded to the Spanish GAP value for nectarines resulted in concentrations of captan residues in peaches of 0.26, 0.81, 0.90, 1.0 (2 trials), 1.2, and 1.5 mg/kg.

The concentrations of captan in the four trials on nectarines and seven on peaches, in rank order, were 0.26, 0.81, 0.90 (2 trials), ***1.0*** (2 trials), 1.2, 1.3, 1.5 (2 trials), and 1.8 mg/kg. The Meeting estimated a maximum residue level of 3 mg/kg, a STMR value of 1 mg/kg, and a HR value in nectarines (whole fruit) of 1.8 mg/kg. The estimated maximum residue level replaces the current recommendation of 5 mg/kg for nectarines.

Supervised trials on *peach* conducted according to GAP were provided from Australia, Canada, Italy, and the USA. Trials from Chile, Japan, and Spain did not correspond to GAP in those countries and were not evaluated.

The concentration of captan in a trial in Australia was 4.7 mg/kg 6 days after treatment with five sprays of 0.13 kg ai/hl. The GAP value for stone fruit is five applications at 0.1 kg ai/hl with a 7-day PHI.

In Canada, GAP permits application of captan to peaches as two sprays of 3.4 kg ai/ha with a 2-day PHI. In five trials, the concentrations of captan were 3.2, 5.5, 6.6, 7.3, and 16 mg/kg 1 or more days after the last spray. Residues of THPI were not measured.

As described above, seven trials in Italy were evaluated on the basis of the Spanish GAP for stone fruit (0.13–0.15 kg ai/hl; PHI, 10 days), as the Italian GAP value was not provided The concentrations of captan were 0.26, 0.81, 0.90, 1.0 (2 trials), 1.2, and 1.5 mg/kg. THPI residues were not measured.

In the USA, the GAP value for peaches is 2.2–4.5 kg ai/ha with a PHI of 0 days. The concentrations of captan in 10 trials were 2.0, 4.3 (2 trials), 5.8, 6.0, 7.4, 7.8, 10, 12, and 14 mg/kg, and those of THPI were < 0.05 (4 trials), 0.07, 0.08, 0.15, 0.18, 0.29, and 0.33 mg/kg.

The concentrations of captan in the 23 trials in peaches, in rank order, were 0.26, 0.81, 0.90, 1.0, 1.0, 1.2, 1.5, 2.0, 3.2, 4.3, 4.3, ***4.7***, 5.5, 5.8, 6.0, 6.6, 7.3, 7.4, 7.8, 10, 12, 14, and 16 mg/kg. The Meeting estimated a maximum residue level of 20 mg/kg, a STMR value of 4.7 mg/kg, and a HR value for captan in peaches (whole fruit basis) of 16 mg/kg. The estimated maximum residue level replaces the current recommendation of 15 mg/kg for peaches.

In the USA, captan is registered for use on *blueberry* at a rate of 1.1–2.7 kg ai/ha with a 0-day PHI. The concentrations of captan in 16 trials that complied with GAP were 2.0–18 mg/kg, and those of THPI were < 0.05–0.17 mg/kg.

The concentrations of captan in the 16 trials in blueberries, in rank order, were 2.0, 3.2, 3.9, 4.0, 4.2, 4.8, 5.4, 6.5, ***6.9*** (2 trials), 7.1, 8.2, 8.3, 8.4, 15, and 18 mg/kg. The Meeting estimated a maximum residue level of 20 mg/kg, a STMR value of 6.9 mg/kg, and a HR value for captan in blueberries of 18 mg/kg. The estimated maximum residue level confirms the current recommendation of 20 mg/kg for blueberries.

Data were available from supervised trials on *grape* conducted according to GAP in Australia, Brazil, Germany, Japan, and the USA. Trials from Chile and France did not correspond to GAP and were not evaluated.

GAP in Australia allows a maximum of five applications at 0.1 kg ai/hl with harvesting 7 days after the final spray. In two trials, the concentrations of captan were 3.6 and 3.4 mg/kg, and those of THPI were 0.09 and 0.10 mg/kg.

The concentrations of captan in grapes in two trials conducted according to GAP in Brazil (0.11–0.12 kg ai/hl; PHI, 1 day) were 0.78 and 2.5 mg/kg.

Four trials in Germany were evaluated with the GAP for Belgium (0.12 kg ai/hl; PHI, 42 days), as the GAP value in Germany was not provided. The concentrations of captan were 0.79, 3.3, 4.7, and 6.3 mg/kg 35 days after the last of 10 sprays at 0.09 kg ai/hl.

In Japan, captan is registered for use on grapes at a maximum of five sprays at 0.1 kg ai/hl (2–3 kg ai/ha) with a PHI of 30 days. The concentrations of captan in nine indoor trials were 0.64, 0.79, 1.1, 1.8, 1.9, 2.1, 2.2, 6.3, and 7.7 mg/kg. When captan was applied to grapes in four outdoor trials, the concentrations were 0.7, 2.9, 7.1, and 9.7 mg/kg.

In nine trials conducted according to GAP in the USA (1.1–2.2 kg ai/ha; PHI, 0 day), the concentrations of captan in grapes were 1.3, 3.5, 3.7, 6.4, 7.2, 7.4, 8.4, 11, and 22 mg/kg, and those of THPI were < 0.05 (3 trials), 0.07, 0.11, 0.14 (2 trials), 0.22, and 0.28 mg/kg.

The concentrations of captan in grapes in 23 trials, in rank order, were 0.65, 0.78, 0.79, 1.3, 2.4, 2.5, 2.9, 3.3, 3.4, 3.5, 3.6, ***3.7***, 4.7, 6.3 (2 trials), 6.4, 7.1, 7.2, 7.4, 7.7, 8.4, 11, and 22 mg/kg. The Meeting estimated a maximum residue level of 25 mg/kg, a STMR value of 3.7 mg/kg, and a HR value for captan in grapes of 22 mg/kg. The estimated maximum residue level confirms the current recommendation of 25 mg/kg for grapes.

Supervised trials on *raspberry* carried out in the USA were evaluated according to the Canadian GAP (2 kg ai/ha; PHI, 2 days). The Meeting considered that the decrease in residues of captan was slow and that the concentrations in raspberries 0 and 3 days after the last spray could be used to estimate a maximum residue level and a STMR value. The concentrations of captan in five trials in the USA in which raspberries were treated at 1.8–2.3 kg ai/ha and harvested 0–3 days after the last spray were, in rank order, 5.7, 7.7, ***8.3***, 13, and 18 mg/kg. The Meeting estimated a maximum residue level of 20 mg/kg, a STMR value of 8.3 mg/kg, and a HR value for captan in raspberries of 18 mg/kg.

Data were available from supervised trials on *strawberry* conducted according to GAP in Belgium, Hungary, the Netherlands, Spain, and the USA.

In Belgium and the Netherlands, GAP permits application of captan at 0.12 kg ai/hl with a 4-day PHI for field-grown strawberries and a 14-day PHI for strawberries grown in a glasshouse. The concentrations of captan were 2.4 mg/kg in field-grown strawberries after 4 days in Belgium and 0.18, 0.13, 0.25, and 0.07 mg/kg in glasshouse-grown strawberries after 14 days in Belgium and the Netherlands. Trials conducted in Germany were evaluated with the GAP for Belgium, as those for Germany were not reported. The concentrations in two field trials were 1 and 2 mg/kg 3 days after a single spray at 0.13 kg ai/hl.

GAP in Hungary permits application of three sprays of captan at 1–1.5 kg ai/ha (0.1–0.15 kg ai/hl) with a 10-day PHI. The concentration in a single trial was 0.93 mg/kg, while that of THPI was < 0.1 mg/kg.

The concentration of captan in strawberries in a single Spanish trial that complied with GAP (0.13–0.15 kg ai/hl; PHI, 21 days) was < 0.01 mg/kg, and that of THPI was 0.15 mg/kg.

Use of captan on strawberries in the USA is permitted at a rate of 1.6–3.4 kg ai/ha with harvesting on the day of the last application. The concentrations of captan in 10 trials were 2.0, 2.6, 3.9, 4.4, 5.4, 7.7, 8.7, 10, and 12 (2 trials) mg/kg, and those of THPI were 0.15, 0.19, 0.22, 0.23, 0.3, 0.34, 0.5, 0.53, 0.9, and 1.4 mg/kg.

The Meeting considered that the indoor trials in Belgium and the Netherlands and the field trial in Spain represented different populations of residues and could not be used to estimate a STMR value. The concentrations of captan in strawberries in 14 trials, in rank order, were 0.93, 1.0, 2.0, 2.0, 2.4, 2.6, ***3.9***, ***4.4***, 5.4, 7.7, 8.7, 10, and 12 (2 trials) mg/kg. The Meeting estimated a maximum residue level of 15 mg/kg, a STMR value of 4.2 mg/kg, and a HR value for captan in strawberries of 12 mg/kg. The estimated maximum residue level replaces the current recommendation of 30 mg/kg for strawberries.

Data were available from supervised trials on *melon* conducted according to GAP in Japan and the USA.

In four field trials in Japan, where the GAP value is 0.13 kg ai/hl or 2–4 kg ai/ha with a PHI of 14 days, the concentrations of captan were 3.6, 4.0, 4.1, and 4.6 mg/kg. Values < 0.005 mg/kg were found in eight indoor trials.

Trials conducted in the USA were evaluated with the Mexican GAP (1–1.5 kg ai/ha, with no specification of the interval between the last spray and harvesting, implying that harvesting on the day of the last spray is permitted), as GAP was not specified for the USA. The concentrations of captan in nine trials conducted at 2.2 kg ai/ha with harvesting on the day of the last of seven applications were 0.29, 0.36, 0.52, 0.56, 1.1, 1.8, 2.0, 2.9, and 6.7 mg/kg.

The Meeting decided that the residues in the indoor trials in Japan represented a different population from the others and discounted them for the purposes of estimating the STMR value. The concentrations of captan in melons in 13 trials, in rank order, were 0.29, 0.36, 0.52, 0.56, 1.1, 1.8, ***2.0***, 2.9, 3.6, 4.0, 4.1, 4.6, and 6.7 mg/kg. For the purposes of estimating the STMR and HR values for use in assessing dietary intake, it was noted that peeling reduced the concentration of captan in cantaloupe by 98% in a processing study in the USA (TMN-634A). The Meeting estimated a maximum residue level of 10 mg/kg, a STMR value of 0.04 (2.0/0.02), and a HR value for captan in melons excluding watermelon of 0.13 (6.7/0.02) mg/kg.

Data were available from supervised trials on *cucumber* conducted according to GAP in Brazil and Japan.

Captan is registered for use on cucumbers in Brazil at a spray concentration of 0.1 kg ai/hl with a 1-day PHI. The concentrations of captan in two trials were 0.06 and 0.16 mg/kg.

In six trials conducted according to GAP in Japan (0.1–0.13 kg ai/hl or 1.5–4 kg ai/ha; PHI, 1 day), the concentrations was 1.9 mg/kg in two indoor trials and 0.20, 0.24, 1.2, and 1.5 mg/kg in four outdoor trials.

The Meeting decided that the residues in the Japanese trials conducted indoors represented a different population from the others and discounted them for the purposes of estimating the maximum residue level and STMR value. The concentrations of captan in six trials in cucumbers, in rank order, were 0.06, 0.16, 0.20, ***0.24***, 1.2, and 1.5 mg/kg. The Meeting estimated a maximum residue level of 3 mg/kg, a STMR value of 0.22 mg/kg, and a HR value for captan in cucumbers of 1.5 mg/kg.

Although four trials on *squash* were reported from the USA, they could not be evaluated because the trial conditions did not correspond to GAP. There was insufficient information to recommend a maximum residue level for squash.

Data were available from supervised trials in Brazil and Japan on *tomato* conducted according to GAP. In four trials conducted according to the GAP in Brazil (0.11–0.12 kg ai/hl; PHI, 1 day), the concentrations of captan were 0.02, 0.12, 0.18, and 0.46 mg/kg. THPI was not measured in one of the trials, but the concentrations in the other three were 0.08, 0.09, and 0.27 mg/kg.

Captan is registered for use on tomatoes in Japan at 0.007–0.1 kg ai/hl (1–3 kg ai/ha) with a 1-day PHI. The concentrations of captan in tomatoes in four indoor trials were 0.40, 0.45, 0.78, and 1.1 mg/kg, and those in 12 outdoor trials were 0.22, 0.28, 0.29, 0.45, 0.50, 0.61, 0.66, 0.76, 0.79, 1.0, 1.7, and 2.3 mg/kg. Residues of THPI were not measured.

The Meeting decided that the residues in the Brazilian trials represented a different population from the others and discounted them for the purposes of estimating the STMR value. The concentrations of captan in tomatoes in the 16 trials in Japan, in rank order, were 0.22, 0.28, 0.29, 0.40, 0.45 (2 trials), 0.50, ***0.61***, ***0.66***, 0.76, 0.78, 0.79, 1.0, 1.1, 1.7, and 2.3 mg/kg. The Meeting estimated a maximum residue level of 5 mg/kg, a STMR value of 0.64 mg/kg, and a HR value for captan in tomatoes of 2.3 mg/kg. The estimated maximum residue level replaces the current recommendation of 2 mg/kg for tomatoes.

The single trial from Thailand on *soya bean* could not be evaluated because the information on GAP in Thailand did not specify a PHI. There was insufficient information to recommend a maximum residue level for soya beans.

Data were available from supervised trials on *potato* conducted according to GAP in Brazil and Mexico.

The concentration of captan in a single trial in Brazil conducted according to GAP (0.11–0.12 kg ai/hl; PHI, 14 days) was < 0.01 mg/kg; THPI was not measured. In a separate trial, with harvesting 7 days after the last application, no residues of captan were detected (< 0.05 mg/kg).

In Mexico, captan is registered for application to potatoes at a spray concentration of 0.1–0.2 kg ai/hl with a 7-day PHI. The concentrations of captan and THPI were < 0.05 mg/kg in four trials conducted at 1.5 times the Mexican GAP.

The concentrations of captan in potatoes in the six trials, in rank order, were < 0.01 and ***< 0.05*** (5 trials) mg/kg. The maximum residue level, the STMR value, and the HR value for captan in potatoes were all estimated by the Meeting to be 0.05 mg/kg. The results of many trials in which the GAP was not reported but in which the PHIs and application rates were similar to or greater than those in Brazil and Mexico support the conclusion that the concentration of residues will be < 0.05 mg/kg.

Although eight trials on *radish* were reported from Germany, the GAP was not provided, and they could not be evaluated. There was insufficient information to recommend a maximum residue level for radishes.

Data were available from supervised trials on *almond* conducted according to GAP in the USA. Captan is registered in the USA for use on almonds at a rate of 2.2–4.9 kg ai/ha with a 30-day PHI. The Meeting considered that captan is a surface residue but that shelling gives rise to residues in the nut. In 13 trials, the concentrations of captan were < 0.01, 0.01, < 0.03, 0.04, ***< 0.05*** (7 trials), 0.10, and 0.20 mg/kg in the nut. The Meeting estimated a maximum residue level of 0.3 mg/kg, a STMR value of 0.05 mg/kg, and a HR value for captan in almonds of 0.2 mg/kg. The concentrations of captan in almond hulls 30 days after the last of five sprays at 5 kg ai/ha were 13, 48, and 53 mg/kg. The Meeting estimated a HR for almond hulls of 53 mg/kg.

Although six trials on *chives* were reported from Germany, the GAP was not provided, and they could not be evaluated. There was insufficient information to recommend a maximum residue level for chives.

Fate of residues during processing

Information was provided to the Meeting on the fate of captan and THPI during the processing of lemons, oranges, grapefruit, apples, cherries, plums, grapes, strawberries, tomatoes, melons, cucumbers, and squash, and processing factors were calculated for processed commodities derived from these raw agricultural commodities. As maximum residue levels were not estimated for lemons, mandarins, grapefruit, oranges, and squash, the effect of processing is not discussed further.

Processing factors were calculated for captan only when it was the residue of concern for surveillance and estimation of dietary intake. When the concentration in the processed commodity does not exceed the LOQ, the processing factor is calculated from the LOQ and is prefixed with '<'. In all the studies of processing, heating and cooking had dramatic effects on the concentrations of captan residues.

The processing factors for apples and apple pomace (dry) were < 0.3, < 0.8, 0.23, 0.31, 0.33, 0.8, 0.9, 1.1, 1.3, 1.4, 1.6, and 1.9. When the two factors calculated for residues that are < LOQ are excluded, the mean processing factor is 1.0 (ν = 10). Application of the mean processing factor to the STMR and HR values for apples provides STMR-P and HR-P values for apple pomace (dry) of 4.95 and 7.8 mg/kg, respectively. The Meeting recommended withdrawal of the current recommendation (2 mg/kg) for dry apple pomace.

The processing factors for apples and apple juice (cold pressed) were < 0.3, < 0.8, < 0.8, 0.03, 0.04, 0.05 (4 studies), 0.07, 0.09, 0.1 (3 studies), 0.15, 0.4, 0.5 (2 studies), 0.6, 0.7, 1.2, and 1.6. The mean processing factor, after exclusion of factors for residues in the processed commodity < LOQ, is 0.3 (ν = 19). Application of the mean processing factor to the STMR and HR values for apples provides STMR-P and HR-P values for juice of 1.5 and 2.3 mg/kg, respectively.

Washing apples removed approximately 50% of the captan residues, and negligible amounts remained after peeling. Captan is readily degraded on heating, such that the processing factors for pasteurized juice, apple sauce, apple jelly, and canned slices are essentially 0. The mean processing factor for dried apples, after exclusion of factors for residues in the processed commodity < LOQ, is 0.85.

A processing factor of 0.3 was obtained for washed cherries. As canning of cherries involves heating, no residues of captan were detectable. Washing peaches reduced the concentration of captan by 60%.

A processing factor of 0.1 was obtained for plums and prunes. Application of the processing factor to the STMR and HR values for plums results in STMR-P and HR-P values for dried plums (prunes) of 0.14 and 0.79 mg/kg, respectively.

The processing factors for grapes and raisins were 1, 1.2, 1.2, 1.3, and 2.6 (mean, 1.5). Application of the mean processing factor to the STMR and HR values for grapes results in a STMR-P value of 5.6 mg/kg and a HR-P value of 33 mg/kg for raisins. The Meeting estimated a maximum residue level for captan in dried grapes (currants, raisins, and sultanas) of 50 mg/kg, which confirms the current recommendation.

Captan did not concentrate in wine, pasteurized juice, depectinized juice, or grape jelly. For these commodities, the mean processing factors were < 0.05. The processing factors for washed fruit, destemmed crushed grapes, cold pressed juice, wet pomace (cold pressed), and dry pomace were 0.8, 0.2, 0.4, 1, and 0.6, respectively.

A processing factor of 0.1 was obtained for washed strawberries. Cooking strawberries resulted in no detectable residues of captan.

The processing factors for tomato and tomato juice were < 0.04 and < 0.1, while those for tomato and tomato puree were < 0.04 and < 0.1. Application of a processing factor of 0.1 to the STMR and HR values for tomatoes provides STMR-P and HR-P values for juice of 0.06 and 0.23 mg/kg, respectively. The STMR-P and HR-P values for tomato puree, based on a processing factor of 0.1, were 0.06 and 0.23 mg/kg, respectively.

Washing cucumbers reduced the concentration of captan by 80%, while peeling or cooking reduced it to < LOQ. Most of the captan residue in melons was removed by peeling, with processing factors of < 0.01 and 0.3 obtained in the samples reported.

Residues in animal commodities

When captan is fed to animals, it is rapidly hydrolysed and metabolized to THPI, which is the residue of interest. The concentrations of THPI in milk reached a plateau after 1–4 days when dairy cattle were dosed with gelatine capsules at nominal rates equivalent to 10, 30 and 100 ppm. The plateau concentrations of THPI were < 0.01, 0.03, and 0.2 mg/kg after these doses, respectively. The only other metabolite of which significant residues were detected was *trans*-3-hydroxy-1,2,6-trihydrophthalimide, for which plateau concentrations of 0.02, 0.06, and 0.2 mg/kg were found at the three doses,. After 29 days of dosing, the mean concentrations of residues were similar in liver, kidney, and muscle but were much lower in fat. There was an approximately linear trend with dose: the concentrations of the two metabolites in kidney, muscle, and liver were 0.11–0.31 mg/kg at 100 ppm, 0.04–0.12 mg/kg at 30 ppm, and 0.01–0.02 mg/kg at 10 ppm. No residues were detected in fat after administration of the lowest dose. The concentrations declined rapidly when dosing was stopped. The studies indicate that the residues of THPI resulting from feeding of captan at concentrations 10 ppm will not exceed 0.01 mg/kg in milk or 0.05 mg/kg in tissues. If it is assumed that the concentration increases linearly with dose, the residues of THPI resulting from feeding captan at concentrations 5 ppm will not exceed 0.01 mg/kg in milk or tissues, the LOQ in these media of the analytical method provided.

The dietary burden of captan residues in farm animals was estimated by the Meeting on the basis of the diets listed in Appendix IX to the *FAO Manual on the Submission and Evaluation of Pesticide Residues Data for the Estimation of Maximum Residue Levels in Food and Feed* (FAO, 1997). Ruminants may be fed apple pomace (dry) and potato culls. Although no information was available on residues of captan in potato waste and culls, captan is applied to potatoes as a seed and a

foliar treatment. Neither use pattern would be expected to result in detectable residues, and it can be assumed that those in potato culls and processing waste are < LOQ (0.05 mg/kg).

The estimated intakes of captan by beef and dairy cattle are:

Feed item	HR or HR-P (mg/kg)	% dry matter	% of diet		Intake (ppm of diet)	
			Beef cattle	Dairy cows	Beef cattle	Dairycows
Apple pomace (dry)	7.8	–	20	40	1.6	3.1
Potato culls	0.05	20	70	40	0.2	0.1
Almond hulls	53	90	10	10	5.9	5.9
Total			100	80	7.7	9.1

The dietary burdens of captan in beef and dairy cattle are 7.7 and 9.1 ppm, respectively. The dietary burden of cattle is dominated by intake of residues in almond hulls. If almond hulls are not included in the calculation, the estimated dietary burden of beef and dairy cattle is < 5 ppm, which would not result in residues in excess of the LOQ for THPI and its hydroxy metabolites in milk and bovine tissues. The Meeting decided that it was inappropriate to estimate maximum residue levels for animal commodities on the basis of such a minor animal feed commodity. Should future uses result in residues of captan in significant animal feeds, this study provides a good basis for setting maximum residue levels in animal commodities.

Dietary risk assessment

Chronic intake

The periodic review of captan resulted in recommendations for new and revised MRLs and new STMR values for raw and processed commodities. Data on consumption were available for 19 food commodities and were used in calculating dietary intake. The results are shown in Annex 3. The IEDIs for the five GEMS/Food regional diets, based on the estimated STMR values, represented 0–8% of the ADI. The Meeting concluded that long-term intake of residues of captan from uses that have been considered by the JMPR is unlikely to present a public health concern.

Short-term intake

The 2000 JMPR concluded that it was unnecessary to establish an acute RfD for captan. This conclusion was based on the considerations that the pesticide is unlikely to present an acute toxicological hazard, and its residues are therefore unlikely to present an acute risk to consumers.

4.3 Carbaryl

Toxicological evaluation

While it was evaluating carbaryl, the Meeting became aware of new studies, which have either become available recently or are under way, that are likely to be crucial to the evaluation (in addition to the data that were submitted).

As some of these studies were submitted shortly before the Meeting, there was insufficient time to evaluate them critically, and the Meeting postponed the evaluation of cabaryl to 2001. At that time, the Meeting proposes to evaluate studies on the following aspects and any other relevant studies that may become available:

- developmental toxicity in rats
- developmental toxicity in rabbits

- two-generation reproductive toxicity in rats
- developmental neurotoxicity in rats.

In the meantime, the ADI of 0–0.003 mg/kg bw was maintained.

4.4 Chlormequat

Residue and analytical aspects

Chlormequat was evaluated within the CCPR periodic review programme in 1994. The Meeting estimated maximum residue levels for a number of commodities, which were recorded as guideline levels only, since the ADI was withdrawn. The 1994 JMPR noted that feeding studies in farm animal and analytical methods for residues in animal products would be desirable. As an ADI was allocated by the 1997 JMPR, the estimates made in 1994 were recommended for use as MRLs in 1997.

The CCPR at its thirtieth session noted that animal transfer studies in poultry and cattle would be available in 1998.

The compound was reviewed toxicologically again in 1999, when an acute RfD was allocated. The 1999 JMPR recommended that an evaluation of residues should be scheduled shortly so that an acute risk assessment could be concluded.

Analytical methods for the determination of residues of chlormequat in water, cereals, pears, and animal products, data on stability in storage of animal products, data on residues in pears and cereals, and the results of a feeding study in dairy cattle and poultry were made available to the Meeting by the manufacturers. The Netherlands submitted its official method of analysis for chlormequat in pears. Information on national MRLs and GAP was provided by the governments of Germany, the Netherlands, and Poland .

Methods of analysis

Chlormequat is difficult to analyse because of its chemical nature and because the residue must be separated from native quarternary ammonium compounds in plant material. Older methods involve lengthy clean-up, liquid–liquid partition or column chromatography (ion-exchange, alumina), and semi-quantitative thin-layer chromatographic or photometric detection, but these methods allow only poor reproducibility. More recent methods are based on head-space gas chromatography after pyrolysis of chlormequat to acetylene in alkaline medium, HPLC by ion-pair chromatography with conductivity detection, or liquid chromatography with mass spectrometric detection.

For cereal grains, the LOQ was 0.05 mg/kg with ion-pair chromatography and 1 mg/kg with head-space gas chromatography with flame ionization detection. The latter method resulted in high values in samples from untreated control plots. The liquid chromatography–mass spectrometric method was used to determine chlormequat residues in pears (LOQ, 0.3 mg/kg).

The ion chromatographic method was validated for animal products, resulting in LOQs of 0.05 mg/kg for eggs and tissues and 0.01 mg/kg for milk. The ion chromatographic technique was also used to analyse chlormequat in water, with an LOQ of 0.05 mg/l.

Stability of residues in stored samples

Two samples each of milk, eggs, liver, and fat from farm animals fed chlormequat were stored for 25–33 months at –18 °C. The remaining compound represented 76–140% of the initial concentration in milk, 45–100% in eggs, 60–82% in liver, and 71–90% in fat, with great variation. The

Meeting was not able to decide whether chlormequat is stable in enzyme-containing matrices and noted that the study was inadequate.

Results of supervised trials

The present Meeting received the results of new supervised trials on pears and cereals. These data and those reported by the 1994 JMPR on which the recommended MRLs for numerous commodities are based were re-evaluated in the view of current GAP and to estimate STMR and HR values.

Chlormequat is registered for use on *pear* in Blgium (at four to five applications of 1.4 kg ai/ha, 0.24 kg ai/hl, 600 l water/ha), Denmark (at two applications of 0.75–1.8 kg ai/ha, 0.075–0.18 kg ai/hl, 1000 l water/ha), the Netherlands (at one or two applications of 0.75–2.3 kg ai/ha, 0.094–0.15 kg ai/hl, 800–1500 l water/ha), and Spain (at fave to six applications of 0.9 kg ai/ha, 0.1 kg ai/hl, 900 l water/ha). The PHIs range from 42 days in Denmark to 90 days in the Netherlands, or treatment is fixed at a certain growth stage (Belgium, Spain).

Six trials carried out in the Netherlands in 1968 were not included in the assessment as no information on the spray concentration was received, but the application rates used in two trials conducted in 1983 (two applications of 1.1–1.8 kg ai/ha, 0.11–0.18 kg ai/hl, 1000 l water/ha) were acceptable in respect of GAP in the Netherlands. The concentrations of residues were 5.3 and 6.9 mg/kg (calculated as chlormequat chloride) 124 and 113 days after the last treatment, respectively. Two further trials (four applications of 1.2–1.6 kg ai/ha, 0.2 kg ai/hl, 600 l water/ha; PHI, 90 and 101 days) complied with the Belgian GAP. The concentrations of residues were 1.6 and 8.1 mg/kg, calculated as chlormequat chloride.

Eight supervised trials were conducted in France in 1998 and 1999. Those carried out in 1998 were in accordance with the Belgian GAP (five applications of 1.4–1.5 kg ai/ha, 0.24 kg ai/hl, 600 l water/ha). The concentrations 44 or 45 days after the last treatment were 4, 4.6, 5.6, and 7.5 mg/kg, calculated as chlormequat chloride. In 1999, only one application was given. The rates used in these trials were not compatible with a currently registered GAP.

The concentrations of residues found in the trials conducted according to GAP were, in rank order (median in italics), 1.6, 4, 4.6, ***5.3***, ***5.6***, 6.9, 7.5, and 8.1 mg/kg calculated as chlormequat chloride or 1.2, 3.1, 3.6, ***4.1***, ***4.3***, 5.3, 5.8, 6.3 mg/kg calculated as chlormequat cation. The Meeting estimated a maximum residue level of 10 mg/kg, confirming the previous recommendation, a STMR value of 4.2 mg/kg, and a HR value of 6.3 mg/kg for pears, calculated as chlormequat cation.

The Meeting received the results of numerous supervised trials on *barley* carried out in the United Kingdom, but these data could not be evaluated as high values were determined in samples from untreated plots and no information was submitted about the analytical method used. Trial carried out in Latvia in 1998 and in Hungary in 1991 provided no information on application rates or the analytical method used.

The supervised trials reported by the 1994 JMPR that are in accordance with current GAPs were re-evaluated:

Country	No. of trials	Concentration of residues, calculated as chlormequat chloride (mg/kg)	In accordance with GAP of
Summer barley			
Denmark	4	< 0.05 (2 trials), 0.05, 0.3	Netherlands, Belgium
Germany	2	0.17, 0.62	Netherlands, Belgium
Sweden	7	< 0.05 (4 trials), 0.1, 0.19, 0.73	Netherlands
United Kingdom	3	0.18, 0.24, 0.37	United Kingdom
Winter barley			
Denmark	1	0.05	Netherlands
France	11	< 0.05 (3 trials), 0.16, 0.18, 0.21, 0.24, 0.29, 0.3 (2 trials), 0.35	Netherlands, Belgium
Germany	5	1.3, 1.6, 1.6, 2.1, 2.3	Germany
Germany	2	0.17, 0.18	Netherlands, Belgium
Sweden	1	0.42	Netherlands, Belgium
Switzerland	2	0.23, 0.29	Netherlands, Belgium
United Kingdom	9	< 0.05 (2 trials), 0.05, 0.07, 0.15, 0.24, 0.36, 0.43, 0.58	United Kingdom

The 47 values for residues, in rank order, were: < 0.05 (11 trials), 0.05 (3 trials), 0.07, 0.1, 0.15, 0.16, 0.17 (2 trials), 0.18 (3 trials), ***0.19***, 0.21, 0.23, 0.24 (3 trials), 0.29 (2 trials), 0.3 (3 trials), 0.35, 0.36, 0.37, 0.42, 0.43, 0.58, 0.62, 0.73, 1.3, 1.6 (2 trials), 2.1, and 2.3 mg/kg calculated as chlormequat chloride, or < 0.04 (11 trials), 0.04 (3 trials), 0.05, 0.08, 0.12 (2 trials), 0.13 (2 trials), 0.14 (3 trials), ***0.15***, 0.16, 0.18, 0.19 (3 trials), 0.22 (2 trials), 0.23 (3 trials), 0.27, 0.28, 0.29, 0.33 (2 trials), 0.45, 0.48, 0.57, 1.0, 1.2 (2 trials), 1.6, and 1.8 mg/kg calculated as chlormequat cation.

The Meeting estimated a maximum residue level of 2 mg/kg to replace the previous recommendation of the 1994 JMPR (0.5 mg/kg), a STMR value of 0.15 mg/kg, and a HR value of 1.8 mg/kg for barley, calculated as chlormequat cation.

The Meeting received the results of four supervised trials on *oats* carried out in 1993 in Austria, but the data could not be evaluated as high values were determined in samples from untreated plots. One trial in Germany and one in the United Kingdom were conducted in accordance with Belgian and British GAP, respectively. The concentrations were 3 and 0.8 mg/kg in oat grains, calculated as chlormequat cation.

The trials carried out in accordance with current GAPs and summarized by the 1994 JMPR were re-evaluated:

Country	No. of trials	Concentration of residues, calculated as chlormequat chloride (mg/kg)	In accordance with GAP of
Germany	16	0.09, 0.14, 0.45, 0.51, 0.9, 1.1, 1.2, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.4, 2.4, 3.3	Belgium, Finland, Netherlands
Germany	2	1.5, 3.7	Germany
United Kingdom	3	0.1, 0.63, 9.2	United Kingdom

The 23 values (21 from submissions in 1994, two from submissions in 2000), in rank order, were 0.09, 0.1, 0.14, 0.45, 0.51, 0.63, 0.8, 0.9, 1.1, 1.2, ***1.5*** (2 trials), 1.6, 1.7, 1.8, 1.9, 2.0, 2.4, 2.4, 3, 3.3, 3.7, and 9.2 mg/kg calculated as chlormequat chloride, or 0.07, 0.08, 0.11, 0.35, 0.39, 0.49, 0.62, 0.7, 0.85, 0.93, ***1.2*** (3 trials), 1.3, 1.4, 1.5, 1.6, 1.9 (2 trials), 2.3, 2.6, 2.9, and 7.1 mg/kg calculated as chlormequat cation.

The Meeting estimated a maximum residue level of 10 mg/kg, confirming the previous recommendation, a STMR value of 1.2 mg/kg, and a HR value of 7.1 mg/kg for oats, calculated as chlormequat cation.

Triticale, rye and wheat have comparable use patterns in the GAP of Belgium, Denmark, Germany, and the United Kingdom. The Meeting received the results of four trials each on triticale and on rye (2.5–5 kg ai/ha) in the United Kingdom, which were not in accordance with the GAP (maximum, 1.7 kg ai/ha). Two Austrian trials each on rye and wheat could not be evaluated as high values were determined in samples from untreated plots. Eight trials on wheat in the United Kingdom could not be evaluated as information on the analytical method used was not submitted. One trial of wheat was carried out in Latvia in 1998, but no information on the application rate or the analytical method used was received. In two trials conducted in Germany in 1988, the application rates were acceptable with regard to British, Italian, and Finnish GAP (1.5–1.7 kg ai/ha); the concentrations were 0.2 and 0.24 mg/kg, calculated as chlormequat chloride.

The supervised trials in accordance with current GAPs and summarized by the 1994 JMPR were re-evaluated:

Country	No. of trials	Concentration of residues, calculated as chlormequat chloride (mg/kg)	In accordance with GAP of
Summer rye			
Germany	4	0.06, 1.5, 2.1, 2.6	Belgium
Winter rye			
Germany	13	< 0.05, 0.22, 0.24, 0.3 (2 trials), 0.33, 0.34, 0.45, 0.62, 0.88, 1.2, 1.4, 1.9	United Kingdom
Germany	2	0.45, 1.8	Germany
Germany	7	< 0.05, 0.05, 0.07, 0.08, 0.09 (2 trials), 0.43	Netherlands
Summer wheat			
Germany	9	0.31, 0.39, 0.52, 0.59, 0.68, 1.2, 1.3 (2 trials), 1.5	Austria, Germany, Finland, United Kingdom
Germany	8	0.09, 0.32, 0.33, 0.41, 0.44 (2 trials), 0.48, 0.59	Finland, United Kingdom
Germany	2	0.81, 1.5	Netherlands
Winter wheat			
Denmark	1	0.15	Belgium
France	3	< 0.05 (3 trials)	Belgium
Germany	6	0.17, 0.23, 0.28, 0.31, 0.34, 0.37	Denmark, United Kingdom
Germany	2	0.28, 0.62	Belgium, Germany, Netherlands
United Kingdom	2	0.05, 1.4	United Kingdom

The concentrations of residue in 26 trials in *rye grain*, in rank order, were < 0.05 (2 trials), 0.05, 0.06, 0.07, 0.08, 0.09 (2 trials), 0.22, 0.24, 0.3 (2 trials), ***0.33***, ***0.34***, 0.43, 0.45 (2 trials), 0.62, 0.88, 1.2, 1.4, 1.5, 1.8, 1.9, 2.1, and 2.6 mg/kg calculated as chlormequat chloride, or < 0.04 (2 trials), 0.04, 0.05 (2 trials), 0.06, 0.07 (2 trials), 0.17, 0.19, 0.23 (2 trials), ***0.26*** (2 trials), 0.33, 0.35 (2 trials), 0.48, 0.68, 0.93, 1.1, 1.2, 1.4, 1.5, 1.6, and 2 mg/kg calculated as chlormequat cation.

The concentrations of residue in 35 trials in *wheat grain* (33 from 1994, 2 from 2000) were < 0.05 (3 trials), 0.05, 0.09, 0.15, 0.17, 0.2, 0.23, 0.24, 0.28 (2 trials), 0.31 (2 trials), 0.32, 0.33, 0.34, ***0.37***, 0.39, 0.41, 0.44 (2 trials), 0.48, 0.52, 0.59 (2 trials), 0.62, 0.68, 0.81, 1.2, 1.3 (2 trials), 1.4, and 1.5 (2 trials) mg/kg calculated as chlormequat chloride, or < 0.04 (3 trials), 0.04, 0.07, 0.12, 0.13, 0.16, 0.18, 0.19, 0.22 (2 trials), 0.24 (2 trials), 0.25, 0.26 (2 trials), ***0.29***, 0.3, 0.32, 0.34 (2 trials), 0.37, 0.4,

0.46 (2 trials), 0.48, 0.53, 0.63, 0.93, 1 (2 trials), 1.1, and 1.2 (2 trials) mg/kg calculated as chlormequat cation.

As the use patterns are comparable and the STMR values are close, the two data sets were combined: < 0.04 (5 trials), 0.04 (2 trials), 0.05 (2 trials), 0.06, 0.07 (3 trials), 0.12, 0.13, 0.16, 0.17, 0.18, 0.19 (2 trials), 0.22 (2 trials), 0.23 (2 trials), 0.24 (2 trials), 0.25, ***0.26*** (4 trials), 0.29, 0.3, 0.32, 0.33, 0.34 (2 trials), 0.35 (2 trials), 0.37, 0.4, 0.46 (2 trials), 0.48 (2 trials), 0.53, 0.63, 0.68, 0.93 (2 trials), 1 (2 trials), 1.1 (2 trials), 1.2 (3 trials), 1.4, 1.5, 1.6, and 2 mg/kg calculated as chlormequat cation.

The Meeting estimated a maximum residue level of 3 mg/kg, a STMR value of 0.26 mg/kg, and a HR value of 2 mg/kg, calculated as chlormequat cation, for rye and wheat, and recommended that these values be extrapolated to triticale. The previous MRL recommended by the 1994 JMPR for rye (3 mg/kg) was confirmed, whereas that for wheat (2 mg/kg) was replaced.

Chlormequat is registered for use on *rape-seed* in Belgium (at 0.69 kg ai/ha) and in the United Kingdom (at 1.9 kg ai/ha). No new GAP and no data on residues were submitted.

The 1994 JMPR estimated a maximum residue level of 5 mg/kg for rape-seed on the basis of one British and nine German trials. The concentrations of residues, in rank order, were 1.7, 2.1, 2.2, 2.3, ***2.6***, *2.7*, 2.9, 3,7, 4.3, and 5.8 mg/kg calculated as chlormequat chloride or 1.3, 1.6, 1.7, 1.8, *2*, ***2.1***, 2.2, 2.8, 3.3, 4.5 mg/kg calculated as chlormequat cation.

The Meeting estimated a STMR value of 2.05 mg/kg for rape-seed.

The 1994 JMPR estimated a maximum residue level of 20 mg/kg (fresh weight) for *dry straw and fodder of barley, oat, rye, and wheat.* The 2000 JMPR considered the results of all the available supervised trials conducted according to current GAPs:

Country	No. of trials	Concentration of residues, calculated as chlormequat chloride (mg/kg)	In accordance with GAP of
Summer barley straw			
Denmark	4	1.3, 2.7, 4.3, 4.4	Netherlands, Belgium
Germany	2	4, 4.4	Netherlands, Belgium
United Kingdom	3	1.6, 1.6, 4.9	United Kingdom
Winter barley straw			
Denmark	1	0.9	Netherlands
France	11	0.36, 1.8, 2.4, 2.8, 3.1, 4.4, 4.7, 5.4, 5.5, 8.5, 11	Netherlands, Spain
Germany	5	5.8, 6.2, 6.4, 8.7, 12	Germany
Germany	2	5.8, 9	Netherlands, Belgium
Switzerland	2	4.2, 4.5	Netherlands, Belgium
United Kingdom	9	0.98, 1, 1.1, 2.2, 2.4 (2 trials), 8.9, 12, 16	United Kingdom
Oat straw			
Germany	16	0.9, 1.2 (2 trials), 1.3, 1.6, 1.9 (2 trials), 2.2, 3.0, 4.0, 4.8, 6.3, 8.2, 9.9 (3 trials)	Belgium, Finland, Netherlands
Germany	2	5.2, 12	Germany
United Kingdom	3	0.48, 3.3, 25	United Kingdom
Summer rye straw			
Germany	4	0.2, 0.3, 4.7, 9	Belgium
Winter rye			
Germany	12	2.2, 2.7, 2.8, 3.1, 4.3, 4.5, 4.8, 5.7, 6.9,	United Kingdom

		9.6 (2 trials), 12	
Germany	1	7.5	Germany
Germany	1	5.5	Netherlands
United Kingdom	2	0.48, 12	United Kingdom
Summer wheat straw			
Germany	9	10, 13, 14, 17, 18 (2 trials), 20, 21, 29	Austria, Germany, Finland, United Kingdom
Germany	8	5.8, 7, 7, 11, 12, 13, 15, 17	Finland, United Kingdom
Germany	2	6.2, 13	Netherlands
Winter wheat straw			
Denmark	1	1.5	Belgium
France	3	2.3, 2.6, 4.8	Belgium
Germany	6	3.9, 4.8, 5.1, 6.1, 6.6, 8.0	Denmark, United Kingdom
Germany	2	7.2, 15	Belgium, Germany, Netherlands
United Kingdom	2	0.5, 5.4	United Kingdom

Two further trials each on oats and wheat were submitted to the current JMPR. The residues of chlormequat chloride were 0.7 and 3 mg/kg in oat straw and 0.5 and 0.9 mg/kg in wheat straw (fresh weight).

The concentrations of residues (fresh weight) in 39 trials with *barley straw*, in rank order, were: 0.36, 0.9, 0.98, 1, 1.1, 1.3, 1.6 (2 trials), 1.8, 2.2, 2.4 (3 trials), 2.7, 2.8, 3.1, 4, 4.2, 4.3, ***4.4*** (3 trials), 4.5, 4.7, 4.9, 5.4, 5.5, 5.8 (2 trials), 6.2, 6.4, 8.5, 8.7, 8.9, 9, 11, 12 (2 trials), and 16 mg/kg calculated as chlormequat chloride or 0.28, 0.7, 0.76, 0.78, 0.85, 1, 1.2 (2 trials), 1.4, 1.7, 1.9 (3 trials), 2.1, 2.2, 2.4, 3.1, 3.3 (2 trials), ***3.4*** (3 trials), 3.5, 3.7, 3.8, 4.2, 4.3, 4.5 (2 trials), 4.8, 5, 6.6, 6.8, 6.9, 7, 8.5, 9.3, 9.3, and 12 mg/kg calculated as chlormequat cation.

The concentrations in 23 trials with *oat straw*, were: 0.48, 0.7, 0.9, 1.2 (2 trials), 1.3, 1.6, 1.9 (2 trials), 2.2, *3* (2 trials), 3.3, 4, 4.8, 5.2, 6.3, 8.2, 9.9 (3 trials), 12, and 25 mg/kg calculated as chlormequat chloride or 0.37, 0.54, 0.7, 0.93 (2 trials), 1, 1.2, 1.5 (2 trials), 1.7, ***2.3*** (2 trials), 2.6, 3.1, 3.7, 4, 4.9, 6.4, 7.7 (3 trials), 9.3, and 19 mg/kg calculated as chlormequat cation.

The values in 20 trials with *rye straw* were: 0.2, 0.3, 0.48, 2.2, 2.7, 2.8, 3.1, 4.3, 4.5, ***4.7***, ***4.8***, 5.5, 5.7, 6.9, 7.5, 9, 9.6 (2 trials), and 12 (2 trials) mg/kg calculated as chlormequat chloride or 0.16, 0.23, 0.37, 1.7, 2.1, 2.2, 2.4, 3.3, 3.5, ***3.7*** (2 trials), 4.3, 4.4, 5.4, 5.8, 7, 7.4 (2 trials), and 9.3 (2 trials) mg/kg calculated as chlormequat cation.

The concentrations in 35 trials with *wheat straw* were: 0.5 (2 trials), 0.9, 1.5, 2.3, 2.6, 3.9, 4.8 (2 trials), 5.1, 5.4, 5.8, 6.1, 6.2, 6.6, 7 (2 trials), ***7.2***, 8, 10, 11, 12, 13 (3 trials), 14, 15 (2 trials), 17 (2 trials), 18 (2 trials), 20, 21, and 29 mg/kg calculated as chlormequat chloride, or 0.39 (2 trials), 0.7, 1.2, 1.8, 2, 3, 3.7 (2 trials), 4, 4.2, 4.5, 4.7, 4.8, 5.1, 5.4 (2 trials), ***5.6***, 6.2, 7.8, 8.5, 9.3, 10 (3 trials), 11, 12 (2 trials), 13 (2 trials), 14 (2 trials), 16 (2 trials), and 22 mg/kg calculated as chlormequat cation.

The 117 values available for *straw* (fresh weight), in rank order, are: 0.16, 0.23, 0.28, 0.37 (2 trials), 0.39 (2 trials), 0.54, 0.7 (3 trials), 0.76, 0.78, 0.85, 0.93 (2 trials), 1, 1, 1.2 (4 trials), 1.4, 1.5 (2 trials), 1.7 (3 trials), 1.8, 1.9 (3 trials), 2, 2.1 (2 trials), 2.2 (2 trials), 2.3 (2 trials), 2.4 (2 trials), 2.6, 3, 3.1 (2 trials), 3.3 (3 trials), 3.4 (3 trials), 3.5 (2 trials), ***3.7*** (6 trials), 3.8, 4, 4.2 (2 trials), 4.3 (2 trials), 4.4, 4.5 (3 trials), 4.7, 4.8 (2 trials), 4.9, 5, 5.1, 5.4 (3 trials), 5.6, 5.8, 6.2, 6.4, 6.6, 6.8, 6.9, 7 (2 trials), 7.4 (2 trials), 7.7 (3 trials), 7.8, 8.5 (2 trials), 9.3 (6 trials), 10 (3 trials), 12 (3 trials), 13 (2 trials), 14 (2 trials), 16 (2 trials), 19, and 22 mg/kg calculated as chlormequat cation.

Allowing for the standard 89% of dry matter (FAO, 1997) in cereal straw (barley, 89%; oats, 90%; rye, 88%; wheat, 88%), the Meeting estimated a maximum residue level and a STMR value for dry straw and fodder of cereal grains of 30 mg/kg and 4.2 mg/kg (3.7/0.89), respectively, calculated as chlormequat cation. The previously recommended MRL of 20 mg/kg (fresh weight) for dry straw and fodder of barley, oats, rye, and wheat is withdrawn.

The 1994 JMPR estimated a maximum residue level of 20 mg/kg for *oat and rye forage* (*green*) on a fresh weight basis. The current Meeting considered the supervised trials that had been conducted according to current use patterns:

Country	No. of trials	Concentration of residues, calculated as chlormequat chloride (mg/kg)	In accordance with GAP of
Oats			
Germany	17	1.1, 1.3, 1.5, 1.8, 2.5, 2.9, 3.1, 3.5, 3.7, 4.3, 6.4, 6.9, 7.6, 8.1, 15, 15, 17	Belgium, Germany, Netherlands
Finland, United Kingdom	1	4.7	United Kingdom
Summer rye			
Germany	4	11, 12, 12, 13	Belgium
Winter rye			
Germany	14	1.9, 2.1, 2.2, 3.6, 4.1, 4.2, 4.3, 4.9, 5.9, 9, 17, 18, 20, 28	Germany, United Kingdom, Netherlands

A further trial on oats was submitted for consideration by the 2000 JMPR, in which the concentration of residue was 28 mg/kg, expressed as chlormequat chloride, in the whole green plant 30 days after treatment.

The concentrations found in all 37 trials on oat and rye forage (fresh weight) were, in rank order, 1.1, 1.3, 1.5, 1.8, 1.9, 2.1, 2.2, 2.5, 2.9, 3.1, 3.5, 3.6, 3.7, 4.1, 4.2, 4.3 (2 trials), 4.7, ***4.9***, 5.9, 6.4, 6.9, 7.6, 8.1, 9, 11, 12 (2 trials), 13, 15 (2 trials), 17 (2 trials), 18, 20, and 28 (2 trials) mg/kg calculated as chlormequat chloride, or 0.85, 1, 1.2, 1.4, 1.5, 1.6, 1.7, 1.9, 2.2, 2.4, 2.7, 2.8, 2.9, 3.2, 3.3 (3 trials), 3.6, ***3.8***, 4.6, 5, 5.3, 5.9, 6.3, 7, 8.5, 9.3 (2 trials), 10, 12 (2 trials), 13 (2 trials), 14, 16, and 22 (2 trials) mg/kg calculated as chlormequat cation.

Allowing for the standard 30% of dry matter in cereal forage (FAO, 1997), the Meeting estimated a maximum residue level of 100 mg/kg and a STMR value of 13 mg/kg (3.8/0.3), calculated as chlormequat cation (dry weight), for oat and rye forage. The previous MRL recommendation (20 mg/kg, fresh weight) is withdrawn.

No new data on residues or GAP were submitted. The 1994 JMPR had received the results of nine supervised trials conducted in Germany at rates within the range of Belgium GAP. For green maize plants, including cobs, the following concentrations (fresh weight) were reported (PHI, 13–35 days): 0.39, 0.92, 1.6, 2.4, ***3.4***, 4.3, 4.8, 5.0, and 6.2 mg/kg calculated as chlormequat chloride or 0.3, 0.71, 1.2, 1.9, ***2.6***, 3.3, 3.7, 3.9, and 4.8 mg/kg calculated as chlormequat cation.

Allowing for the standard 40% of dry matter in maize forage (FAO, 1997), the Meeting estimated a maximum residue level of 15 mg/kg and a STMR value of 6.5 mg/kg (2.6/0.4), calculated as chlormequat cation (dry weight).

For maize fodder, the following concentrations (fresh weight) were reported (PHI, 78–113 days): 0.36, 0.68, 0.8, 2.4, *2.5*, 4.1, 4.3, 4.5, 5.1 mg/kg calculated as chlormequat chloride, or 0.28, 0.53, 0.62, ***1.9*** (2 trials), 3.2, 3.3, 3.5, and 4 mg/kg calculated as chlormequat cation.

Allowing for the standard 83% of dry matter in maize stover (FAO, 1997), the Meeting estimated a maximum residue level of 7 mg/kg and a STMR value of 2.3 mg/kg (1.9/0.83), calculated as chlormequat cation (dry weight).

Residues in animal and poultry commodities

The Meeting estimated the dietary burden of chlormequat residues in farm animals on the basis of the diets listed in Appendix IX of the FAO Manual. Calculation from the MRLs yields maximum concentrations of residues in feed suitable for estimating MRLs for animal commodities. Calculation from the STMR values for feed allows estimation of STMR values for animal commodities.

Commodity	MRL (mg/kg)	Group	% dry matter	MRL/dry matter	Percent of diet			Concentration of residue (mg/kg)		
					Beef cattle	Dairy cows	Poultry	Beef cattle	Dairy cows	Poultry
Barley grain	2	GC	88	2.3						
Barley straw	30	AS	100	30						
Oat grain	10	GC	89	11	35	40	80	3.9	4.5	9.0
Oat forage	100	AF	100	100	25	60		25	60	
Oat straw	30	AS	100	30						
Maize forage	15	AF	100	15	40			6		
Maize fodder	7	AS	100	7						
Rye grain	3	GC	88	3.4						
Rye forage	100	AF	100	100						
Rye straw	30	AS	100	30						
Wheat grain	3	GC	89	3.4			20			0.67
Wheat straw	30	AS	100	30						
Sum					100	100	100	35	65	9.6

Commodity	STMR (mg/kg)	Group	% dry matter	STMR/ dry matter	Percent of diet			Concentration of residue (mg/kg)		
					Beef cattle	Dairy cows	Poultry	Beef cattle	Dairy cows	Poultry
Barley grain	0.15	GC	88	0.17						
Barley straw	4.2	AS	100	4.2						
Oat grain	1.2	GC	89	1.4	35	40	80	0.47	0.54	1.1
Oat forage	12.7	AF	100	13	25	60		3.2	7.6	
Oat straw	4.2	AS	100	4.2						
Maize forage	6.5	AF	100	6.5	40			2.6		
Maize fodder	2.3	AS	100	2.3						
Rye grain	0.26	GC	88	0.30			20			0.06
Rye forage	12.7	AF	100	13						
Rye straw	4.2	AS	100	4.2						
Wheat grain	0.26	GC	89	0.29						
Wheat straw	4.2	AS	100	4.2						
Sum					100	100	100	6.3	8.1	1.1

Cows

Groups of three lactating cows were given chlormequat chloride in the diet twice daily at a dose of 240, 720, or 2400 mg/animal per day, equivalent to 0.4, 1.3, and 4 mg/kg bw per day or 12, 36, and 120 ppm on a dry weight basis, for 28 consecutive days. Two additional animals were treated at the high dose for 28 days and slaughtered 2 and 7 days after the last dose. The doses were equivalent to 0.31, 1, and 3.1 mg/kg bw per day (or 9.3, 28, and 93 ppm), calculated as chlormequat cation. At the lowest dose, the average concentrations of chlormequat chloride residues were 0.029 mg/kg in milk, 0.1 mg/kg in liver, and 0.2 mg/kg in kidney. No residues were found in meat or fat. At the medium and high doses, the plateau concentrations of chlormequat chloride residue in milk were 0.1 and 0.2 mg/kg. Concentrations up to 0.11 mg/kg were determined in some meat and fat samples. The concentrations were 0.1 and 0.4 mg/kg in liver and 0.4 and 0.8 mg/kg in kidney at the two doses, respectively, indicating that the values in kidney were at least twice as high in liver.

The concentrations of chlormequat chloride in skim milk were similar to those in whole milk, but they were two times lower than those in cream because of the solubility of the compound in water.

The concentration of chlormequat residues in milk reached a plateau 10–11 days after the first treatment with the medium dose, but after 3–4 days with the low and high doses. The residues were cleared rapidly from meat, fat, and liver, and none could be determined in these tissues 2 days after the end of dosing. The concentrations in milk and kidney fell to about 20% of their plateau values. After 7 days, the values for milk were below the LOQ of 0.01 mg/kg, but 0.09 mg/kg remained in kidney. Although milk and tissue samples were frozen on the day of sampling, they were analysed in part 1 year later, and no adequate information on stability was received.

According to the recommendation of the 1997 JMPR, the maximum residue level and the STMR value for milk were calculated on the basis of dietary burdens of 65 and 8.1 mg/kg, respectively, for dairy cattle. The maximum residue levels and the STMR values for meat, liver, and kidney were derived from dietary burdens of 35 or 6.3 mg/kg, respectively, for beef cattle. The following table shows the highest and the mean actual and extrapolated concentrations of residues for estimation of MRLs and STMR values for chlormequat.

Dose (ppm)	Concentration of residues (mg/kg), calculated as chlormequat cation									
	Milk		Liver		Kidney		Muscle		Fat	
	High	Mean	High	Mean	High	Mean	High	Mean	High	Mean
MRL for beef cattle										
Extrapolated: 35			0.088	0.078	0.35	0.3	0.11	< 0.04	0.05	< 0.04
Actual: 28			0.07	0.062	0.28	0.24	0.085		0.04	
MRL for dairy cows										
Extrapolated: 65	0.35	0.13								
Actual: 93	0.5	0.18								
STMR value for beef cattle										
Extrapolated: 6.3			0.053	0.042	0.16	0.084	< 0.04	< 0.04	< 0.04	<0.04
Actual: 9.3			0.078	0.062	0.23	0.124				
STMR value for dairy cows										
Extrapolated: 8.1	0.05	0.018								
Actual: 9.3	0.06	0.021								

[a] The mean concentration in milk was calculated from samples taken on days 3–28.

The Meeting estimated maximum residue levels of 0.5 mg/kg for milk, 0.1 mg/kg for liver, 0.5 mg/kg for kidney, and 0.2 mg/kg for meat and recommended that the HR values be 0.35 mg/kg for

milk, 0.088 mg/kg for liver, 0.35 mg/kg for kidney, and 0.11 mg/kg for meat. The estimated STMR values are 0.018 mg/kg for milk, 0.042 mg/kg for liver, 0.084 for kidney, and 0.04 mg/kg for meat. No maximum residue level was recommended for fat.

Chickens

Three groups of four hens were given capsules containing chlormequat chloride at a dose of 0.72, 2.1, or 7.2 mg/bird per day, equal to 6, 18, and 60 ppm on a dry weight basis, for 28 consecutive days. Two additional groups of 12 hens were treated with the high dose for 28 days and slaughtered 2 or 7 days after the last dose. The doses were equivalent to 4.6, 14, and 46 ppm when calculated as chlormequat cation.

The lowest dose resulted in concentrations of chlormequat chloride residues in eggs at or above the LOQ of 0.05 mg/kg, while 0.05 mg/kg was found in liver and none in meat or fat. Plateau concentrations of 0.06 and 0.1 mg/kg were found in eggs of hens treated with the two higher doses after 1 week of dosing. The concentrations in meat and fat samples were below the LOQ of 0.05 mg/kg, while those in liver were 0.07 mg/kg at the medium dose and 0.18 mg/kg at the high dose.

The residues were cleared rapidly from meat, fat, and liver. No chlormequat chloride was determined in meat or fat. The concentrations in liver had fallen to 0.05 mg/kg 2 days after the end of dosing and to below the LOQ after 7 days. After 2 and 7 days, the residues in eggs had fallen to values below the LOQ of 0.05 mg/kg.

Egg and tissue samples were frozen on the day of sampling but were analysed in part 3 months (tissues) or 10 months (eggs) later. No adequate information on stability was received.

According to the recommendation of the 1997 JMPR, the maximum residue level and the STMR values for eggs and poultry tissues were calculated on the basis of dietary burdens of 9.6 and 1.1 mg/kg, respectively. The following table shows the highest and the mean actual and extrapolated concentrations of residues for estimation of MRLs and STMR values for chlormequat.

Dose (ppm)	Concentrations of residues (mg/kg), calculated as chlormequat cation							
	Eggs		Meat		Liver		Fat	
	Highest	Mean	Highest	Mean	Highest	Mean	Highest	Mean
MRL								
Extrapolated: 9.6	0.064	0.032	< 0.04	< 0.04	0.053	0.037	< 0.04	< 0.04
Actual: 14	0.093	0.046			0.077	0.054		
STMR								
Extrapolated: 1.1	0.011	< 0.04	< 0.04	< 0.04	0.017	0.0096	< 0.04	< 0.04
Actual: 4.6	0.047				0.07	0.04		

[a] The mean concentration in eggs was calculated from samples taken on days 3–28.

The Meeting estimated a MRL of 0.1 mg/kg for eggs and liver and 0.04* mg/kg for meat; no MRL was recommended for fat. The estimated STMR values were 0.04 for eggs, 0.0096 for liver, and 0 for meat. HR values of 0.064 mg/kg for eggs, 0.053 mg/kg for liver, and 0 for meat were estimated.

Fate of residues during processing

In three studies of the processing of *rape-seed* reported by the 1994 JMPR, the mean processing factor for crude rape-seed oil was < 0.018. On the basis of the STMR value of 2.0 mg/kg for rape-seed, a STMR-P value of 0.037 mg/kg was estimated for crude rape-seed oil.

One study on the processing of *barley* to barley pearls submitted to the 1994 JMPR indicates a processing factor of 0.06. On the basis of the STMR value of 0.15 mg/kg for barley grain, a STMR-P value of 0.009 mg/kg was estimated for barley pearl. Another study indicated processing factors of 0.69 for malt and 0.015 for beer. On the basis of the STMR value of 0.15 mg/kg for barley, STMR-P values of 0.1 mg/kg and 0.0023 mg/kg were estimated for malt and beer, respectively.

Two studies on the processing of *oats* to oat flakes were submitted to the 2000 JMPR, but only one could be used for evaluation (processing factor, 0.27) because high values were found in samples from untreated plots in the second study. Two further studies were reported by the 1994 JMPR (processing factors, 0.1 and 0.25). On the basis of a STMR value of 1.2 mg/kg for oat grains and a mean processing factor of 0.21, a STMR-P value of 0.25 mg/kg was estimated for oat flakes.

One study on the processing of *rye* was submitted to the 2000 JMPR but could not be used for evaluation because high values were found in samples from untreated plots. In a study reported by the 1994 JMPR, the processing factors were 3.2 for bran, 0.99 for flour, 1.3 for wholemeal, and 0.95 for wholemeal bread. On the basis of the MRL of 3 mg/kg for rye, the following maximum residue levels were estimated: 10 mg/kg for rye bran, 3 mg/kg for rye flour, and 4 mg/kg for rye wholemeal. On the basis of the STMR value of 0.26 mg/kg, STMR-P values were estimated as 0.83 mg/kg for rye bran, 0.26 mg/kg for rye flour, 0.34 mg/kg for rye wholemeal, and 0.25 mg/kg for rye wholemeal bread.

One study on the processing of *wheat* submitted to the 2000 JMPR showed processing factors of 2.5 for wheat bran, 1 for wholemeal, and 0.63 for wholemeal bread. In a study reported by the 1994 JMPR, processing factors of 4.6 for bran, 0.41 for flour, 1.4 for wholemeal, and 0.79 for wholemeal bread were estimated. The following processing factors were estimated: bran, 3.6; flour, 0.41; wholemeal, 1.2; and, wholemeal bread, 0.71. On the basis of the MRL of 3 mg/kg for wheat grain, the following maximum residue levels were estimated: 10 mg/kg for wheat bran, 2 mg/kg for wheat flour, and 5 mg/kg for wheat wholemeal. On the basis of the STMR value of 0.26 mg/kg for wheat grain, STMR-P values of 0.94 mg/kg for wheat bran, 0.11 mg/kg for wheat flour, 0.31 mg/kg for wheat wholemeal, and 0.18 mg/kg for wheat wholemeal bread were estimated.

Further work or information

Desirable

Analytical study of stability in frozen storage of samples of animal products fortified with chlormequat

Dietary risk assessment

Chronic intake

STMR or STMR-P values were estimated by the present Meeting for 27 raw and processed food commodities. When data on consumption were available, these values were used to estimate dietary intake. The results are shown in Annex 3.

The IEDIs for the five GEMS/Food regional diets, based on the estimated STMR values, represented 0–3 % of the ADI. The Meeting concluded that long-term intake of residues of

chlormequat from uses that have been considered by the JMPR is unlikely to present a public health concern.

Short-term intake

The IESTI for chlormequat was calculated for the food commodities (and their processing fractions) for which maximum residue levels and STMR values were estimated and for which data on consumption were available. The results are shown in Annex 4. Pears were the only commodity for which the IESTI exceeded the acute RfD, with values of 240% for the general population and 700% for children.

The Meeting concluded that short-term intake of residues of chlormequat when used, other than on pears, in ways that have been considered by the JMPR is unlikely to present a public health concern.

4.5 Chlorpropham

Chlorpropham, isopropyl *meta*-chlorocarbanilate, is a carbamate derivative of chloroaniline used as a plant growth regulator. It acts by inhibiting root growth and photosynthesis. It is intended for use as a residual herbicide for the pre-emergence control of grass weeds in a variety of fruit and vegetable crops and as a potato-sprout suppressant.

Toxicological evaluation

The toxicity of chlorpropham was evaluated by the Joint Meeting in1963 and 1965; an ADI could not be allocated at either Meeting. A full data package was submitted for consideration by the present Meeting.

After oral administration to rats, [^{14}C-ring]chlorpropham was rapidly and extensively absorbed from the gastrointestinal tract. Excretion in urine represented 82–92% of the administered dose within 24 h, and 3–5% of the dose was excreted in the faeces during this time. After oral or intraperitoneal administration of [^{14}C-side-chain]chlorpropham to rats, about 50% of the dose was excreted in urine within 72 h and the majority within 24 h. Faecal excretion represented about 5% of the dose, and 20–35% was eliminated as $^{14}CO_2$ over 72 h.

The metabolism of chlorpropham in rats, lactating goats, and laying hens is qualitatively similar. Many metabolites have been identified, the main biotransformation pathways being aromatic 4′-hydroxylation, oxidation of the isopropyl side-chain, and carbamate hydrolysis, followed by rearrangement to chloroaniline and conjugation of many of the subsequent products with sulfate or glucuronic acid. In rats, the principal metabolites are the aryl-*O*-sulfate conjugates and 4′-hydroxychlorpropham, the major free metabolite in urine and faeces.

The extensive (about 40%) biliary excretion found after intravenous administration to rats and the low faecal elimination observed after oral dosing indicate that the metabolites excreted in bile are almost completely reabsorbed. After absorption, chlorpropham is rapidly distributed to all tissues, including the brain; maximum levels in tissues are reached within 2 h after dosing and decline rapidly thereafter, with half-times of 3–11 h for radiolabelled material in tissues including blood, fat, and brain. Studies with radiolabelled compound showed minimal tissue accumulation (0.05 mg/kg) after single or repeated (15 days) oral doses of 5 mg/kg bw. After a single intravenous dose of 5 mg/kg bw, no residues were detected in tissues. After oral administration to pregnant rats, radiolabelled material

was readily transferred from the dams to fetuses and, after parturition, from the dams to offspring via the milk.

In goats, rapid absorption and excretion were observed, excretion occurring mainly in urine. Small amounts of radiolabel were excreted in the faeces. Transfer of residues into milk (< 0.5 mg/kg) and hepatic retention (< 0.5 mg/kg) represented only about 1% of the dose, and the amount accumulated in fat and muscle (< 0.03 mg/kg) was one to two orders of magnitude lower. In laying hens, only 0.03% of the administered radiolabel was found in the total egg production (maximum residue, 0.074 mg/kg in egg white and 0.23 mg/kg in egg yolk). Little residual radioactivity was found in tissues and organs: < 0.5 mg/kg in liver, kidneys, fat, and skin; 0.015 mg/kg in thigh muscle; and 0.006 mg/kg in breast muscle.

Chlorpropham has little acute toxicity: the oral LD_{50} in rats was > 2000–4200 mg/kg bw, and the dermal LD_{50} in both rats and rabbits was > 2000 mg/kg bw. Chlorpropham is also only weakly toxic after inhalation; concentrations in air greater than 470 mg/m^3 could not be attained, and no deaths were observed at this concentration. Chlorpropham was not irritating to the eye or skin of rabbits. It did not sensitize the skin of guinea-pigs in a Bühler test, an open epicutaneous test, or a Magnusson Kligman test. Although chlorpropham did sensitize the skin of 30% of the guinea-pigs tested in a split adjuvant test, the Meeting concluded that chlorpropham is unlikely to cause sensitization in humans. WHO has classified chlorpropham as unlikely to present an acute hazard in normal use.

In short-, medium-, and long-term studies of the effects of chlorpropham in mice, rats, and dogs, the haematopoietic system was the main toxicological target, with changes in the morphology and parameters of erythrocytes, including increased methaemoglobin, and changes in the spleen and liver consistent with a haemolytic effect. Damage to erythrocytes was observed at doses of 47 mg/kg bw per day and above in rats. In dogs given diets containing chlorpropham for 28 days or by capsule for 90 days, effects were also seen on the thyroid gland at doses similar to or lower than those that affected the erythrocytes. The LOAEL was 186 mg/kg bw per day in mice (one study), and the NOAEL was 210 mg/kg bw per day in one study in mice, 10 mg/kg bw per day in two studies in rats, and 25 mg/kg bw per day in mice and rats fed chlorpropham in the diet and in dogs treated by capsule for 3 months.

In a long-term study of toxicity in mice, the haematopoietic system was again the main toxicological target, with increased haematopoiesis and haemosiderosis in the spleen, increased hepatic haematopoiesis, and increased bone-marrow cellularity. The NOAEL was 100 mg/kg bw per day. Rats showed effects similar to those observed in mice, with the addition of decreased body-weight gain, an increased urinary concentration of bilirubin, and pigmentation of the reticuloendothelial cells of the liver. The lowest dose, 30 mg/kg bw per day, was the LOAEL. In dogs given chlorpropham by capsule for 60 days, the NOAEL was 5 mg/kg bw per day on the basis of effects on the thyroid gland, including increased weight, decreased concentrations of thyroxine (in a test for stimulation by thyroid-stimulating hormone), and, occasionally, decreased concentrations of tri-iodothyronine. Although changes in erythrocyte parameters were observed at higher doses, accompanied by increased liver weights, they were not as marked as in mice and rats; however, it should be noted that methaemoglobin and Heinz bodies were not measured in this study.

Dermal exposure of rabbits to chlorpropham for 21 days caused skin irritation and microscopic dermal changes at the lowest dose tested (100 mg/kg bw). After systemic absorption, the haematopoietic system was again the main toxicological target, with an increased number of reticulocytes. The NOAEL for systemic effects was 100 mg/kg bw per day.

Chlorpropham was not carcinogenic in mice treated in the diet at doses up to 1000 mg/kg bw per day. It caused a significant increase in the incidence of benign Leydig-cell tumours in a study in rats at a dietary dose of 1000 mg/kg bw per day, the highest dose tested. On the basis of current information, benign Leydig-cell tumours are considered to arise in rats by an indirect, non-genotoxic mechanism involving disturbance of the hormonal control mechanism of the testis. This hypothesis remains to be confirmed in an appropriately designed study.

Chlorpropham was not genotoxic in a number of tests for mutagenicity in bacterial and mammalian cells and for cytogenicity *in vitro* and *in vivo*. Nevertheless, weak or equivocally positive results were obtained in some tests *in vitro*, including two for cell transformation, one for unscheduled DNA synthesis, and one for chromosomal aberrations. The Meeting concluded that, although chlorpropham may be weakly genotoxic *in vitro*, it is unlikely to present a human risk. This conclusion should be validated in adequate studies *in vivo.*

On the basis of the available information, the Meeting concluded that the probability that chlorpropham has carcinogenic potential in humans is remote.

The reproductive toxicity of chlorpropham in rats was investigated in a two-generation study. The NOAEL for maternal toxicity was 1000 ppm, equivalent to 50 mg/kg bw per day, on the basis of effects on the haematopoietic system similar to those observed in other short-term studies. No reproductive toxicity was observed at 10 000 ppm, the highest dose tested, although some developmental toxicity was seen at this dose. In F_1 pups, but not in F_2 pups, dark spleens were observed at a dose of 3000 ppm, indicating developmental toxicity. The NOAEL for developmental toxicity was therefore 1000 ppm, equivalent to 50 mg/kg bw per day.

The developmental toxicity of chlorpropham was studied in rats and rabbits. In rats, the NOAEL for maternal toxicity was 200 mg/kg bw per day on the basis of reduced body-weight gain and food consumption at higher doses. Chlorpropham was embryotoxic only at maternally toxic doses, with a NOAEL of 200 mg/kg bw per day. It was not teratogenic, the NOAEL being 800 mg/kg bw per day, the highest dose tested. In a study in rabbits, signs of maternal toxicity (anorexia, decreased food consumption, and decreased faecal output) were seen at 500 mg/kg bw per day, resulting in a NOAEL of 250 mg/kg bw per day. The NOAEL for embryotoxicity was 125 mg/kg bw per day, on the basis of post-implantation loss at higher doses. Chlorpropham was not teratogenic, the NOAEL being 500 mg/kg bw per day, the highest dose tested. In a second study in rabbits, signs of maternal toxicity (equivocal increase in mortality rate, decreased body-weight gain and food consumption, and increased spleen weights) were evident at 250 and 500 mg/kg bw per day, resulting in a NOAEL of 125 mg/kg per day. Chlorpropham was embryotoxic only at maternally toxic doses, with a NOAEL of 250 mg/kg bw per day. It was not teratogenic, the NOAEL for this effect being 500 mg/kg bw per day, the highest dose tested.

The lowest NOAEL for the effects of chlorpropham on erythrocytes, methaemoglobinaemia, and Heinz body formation was found in Wistar rats treated orally for 90 days. As methaemoglobinaemia is known to be a transient effect, and adaptation occurs after some time, it would have been more appropriate to measure methaemoglobin earlier in the study, rather than after 90 days.

The Meeting concluded that the existing database was adequate to characterize the potential hazard of chlorpropham to fetuses, infants, and children.

The Meeting established an ADI of 0–0.03 mg/kg bw, on the basis of a NOAEL of 10 mg/kg bw per day in the 90-day study of toxicity in Wistar rats and a safety factor of 300. This value includes an additional safety factor of 3 to account for inadequacies in the assessment of

methaemoglobinaemia, the critical toxicological effect. The ADI also provides an adequate margin of safety for the effects on the thyroid observed in dogs (NOAEL, 5 mg/kg bw per day).

The Meeting established an acute RfD of 0.03 mg/kg bw, on the basis of a NOAEL of 10 mg/kg bw per day in the 90-day study of toxicity in Wistar rats and a safety factor of 300. This value includes an additional safety factor of 3 to take account of inadequacies in the assessment of methaemoglobinaemia, the critical toxicological effect.

A toxicological monograph was prepared.

Levels relevant for risk assessment

Species	Study	Effect	NOAEL	LOAEL
Mouse	90-day study of toxicity[a]	Toxicity	–	186 mg/kg bw per day
	78-week study of toxicity and carcinogenicity[a]	Toxicity	100 mg/kg bw per day	500
		Carcinogenicity	1000 mg/kg bw per day[b]	–
Rat	90-day study of toxicity[a]	Toxicity	10 mg/kg bw per day	47 mg/kg bw per day
	24-month study of toxicity and carcinogenicity[a]	Toxicity	–	30 mg/kg bw per day
		Carcinogenicity	500 mg/kg bw per day	1000 mg/kg bw per day
	Two-generation study of reproductive toxicity[a]	Parental and pup toxicity	1000 ppm, equivalent to 50 mg/kg bw per day	3000 ppm, equivalent to 150 mg/kg bw per day
		Reproductive toxicity	10 000 ppm, equivalent to 500 mg/kg bw per day[b]	–
	Developmental toxicity[c]	Maternal and fetal toxicity	200 mg/kg bw per day	800
		Embryotoxicity	200 mg/kg bw per day	800 mg/kg bw per day
Rabbit	Developmental toxicity[c]	Maternal toxicity	250 mg/kg bw per day	500 mg/kg bw per day
		Embryotoxicity	125 mg/kg bw per day	250 mg/kg bw per day
	Developmental toxicity[c]	Maternal toxicity	125 mg/kg bw per day	250 mg/kg bw per day
		Embryo- and fetotoxicity	250 mg/kg bw per day	500 mg/kg bw per day
Dog	90-day study of toxicity[d]	Toxicity	25 mg/kg bw per day	125 mg/kg bw per day
	60-week study of toxicity[d]	Toxicity	5 mg/kg bw per day	50 mg/kg bw per day

[a] Dietary administration
[b] Highest dose tested
[c] Gavage
[d] Capsule

Estimate of acceptable daily intake for humans
0–0.03 mg/kg bw

Estimate of acute reference dose
0.03 mg/kg bw

Studies that would provide information useful for continued evaluation of the compound:
- Time course of methaemoglobinaemia in rats
- Mechanism of benign Leydig-cell tumour development
- Genotoxicity *in vivo*
- Observations in humans

Summary of critical end-points

Absorption, distribution, excretion and metabolism in mammals	
Rate and extent of absorption	Rapid and extensive (~100%), rats
Dermal absorption	No data (rabbit; systemic toxicity at 520 mg/kg bw per day)
Distribution	Low concentrations of residues; highest in blood, liver, and spleen, rat
Potential for accumulation	None
Rate and extent of excretion	Rapid, 85–97% within 24 h, primarily in urine; 3–5% in faeces, rat
Metabolism in animals	Extensive, only 0.3% recovered unchanged in urine and faeces; numerous metabolites: main pathways are aromatic 4′-hydroxylation, isopropyl side-chain oxidation, and carbamate hydrolysis followed by rearrangement to 3-chloroaniline and then conjugation
Toxicologically significant compounds	Chlorpropham and chloroaniline
Acute toxicity	
LD_{50}, oral	4200 mg/kg bw, rat
LD_{50}, dermal	> 2000 mg/kg bw, rat
LC_{50}, inhalation	> 476 mg/m^3, rat
Dermal irritation	Not irritating, rabbit
Ocular irritation	Not irritating, rabbit
Dermal sensitization	Not sensitizing, guinea-pig
Short-term toxicity	
Target/critical effect	Mice, rats, dogs: erythrocyte damage, methaemoglobinaemia in erythrocytes, liver, spleen, and bone marrow; thyroid dysfunction (dogs)
Lowest relevant oral NOAEL	90-day, rat, 10 mg/kg bw per day (diet) 60-week, dog, 5 mg/kg bw per day (diet)
Lowest relevant dermal NOAEL	21-day, rabbit, 104 mg/kg bw per day
Long-term toxicity and carcinogenicity	
Target/critical effect	Mice, rats, dogs: erythrocyte damage, methaemoglobinaemia in erythrocytes, liver, spleen, bone marrow; thyroid dysfunction (dogs)
Lowest relevant NOAEL	2-year, rat, LOAEL 30 mg/kg bw (diet)
Carcinogenicity	Not carcinogenic, mouse. Benign Leydig-cell tumours, rat
Genotoxicity	Weak or equivocal evidence *in vitro* Not genotoxic in limited studies *in vivo*
Reproductive toxicity	
Reproduction target/critical effect	None, rat
Lowest relevant reproductive NOAEL	500 mg/kg bw per day, highest dose tested, rat
Developmental target/critical effect	Post-implantation loss, rabbit; slightly retarded ossification (in the presence of maternal toxicity), rabbit
Lowest relevant developmental NOAEL	125 mg/kg bw per day, rabbit
Neurotoxicity / Delayed neurotoxicity	
Neurotoxicity	No evidence
Other toxicological studies	None
Medical data	None

Summary	***Value***	***Study***	***Safety factor***
ADI	0–0.03 mg/kg bw	90-day, rat, toxicity	300
Acute RfD	0.03 mg/kg bw	90-day, rat, toxicity	300

4.6 Chlorpyrifos (017)

Chlorpyrifos was originally evaluated by the JMPR in 1972 and then several times up to 1995. A toxicological review, at which the ADI was set at 0–0.01 mg/kg bw, was conducted in 1982. At its twenty-fifth session, in 1993, the CCPR (ALINORM 93/24A para 251) identified chlorpyrifos as a candidate for periodic review. At its twenty-ninth session, in 1997, the CCPR scheduled the periodic review of toxicology for 1999 and that of residues for 2000. Information was supplied to the Meeting by the manufacturer on the identity and physical properties of the active ingredient and technical material, metabolism in animals and plants, environmental fate, analytical methods, stability in storage, supervised field trials, GAP (national labels), national monitoring data, raw agricultural commodity processing, and residues in animal commodities.

Residue and analytical aspects

Metabolism

Animals and birds

Two female *goats* were fed [^{14}C]chlorpyrifos in gelatin capsules twice daily for 10 days for a total dose of 0.26 mCi/goat per day and dietary intakes of 15 and 19 ppm. Urine and faeces contained 79–89% of the administered dose, and about 2% was found in milk and tissues combined. The concentration of residue in milk attained a maximum on day 8 (0.047 mg/kg) and then fell slightly. The concentrations in the tissues of the two goats, respecctively, expressed as equivalents of chlorpyrifos, were: fat, 0.10 and 0.22; liver, 0.18 and 0.27; kidney, 0.26 and 0.35; muscle, 0.03 and 0.03; and skin, 0.11 and 0.18 mg/kg. When tissues were hydrolysed with 0.6 N potassium hydroxide, > 94% of the radiolabelled residue in all tissues and 92–94% of that in milk was 3,5,6-trichloropyridinol. Chlorpyrifos and 3,5,6-trichloropyridinol represented 70 and 14% of the recovered activity in solvent extracts of milk, 76 and 21% in fat, 1.9 and 84% in liver, and 0.9 and 92% in kidney. The oxygen analogue of chlorpyrifos was not detected.

In a study in *poultry*, acclimatized white Leghorn laying hens received a daily oral dose of 2.26 mg of [^{14}C-2 and ^{14}C-6]chlorpyrifos for 10 days. Ring C-2 is adjacent to the thiophosphate. The concentrations of chlorpyprifos equivalents in treated tissues were: kidney, 0.15 mg/kg; liver, 0.054 mg/kg; muscle, 0.10 mg/kg; fat, 0.20 mg/kg; skin, 0.13 mg/kg; gizzard, 0.024 mg/kg; and heart, 0.068 mg/kg. Eggs were separated into yolk and whites and combined by group and day. The concentration of radiolabel in the whites reached a plateau of 0.026 mg/kg on day 7, and that in the yolks appeared to reach a plateau of 0.15 mg/kg on day 9 or 10. Chlorpyrifos and 3,5,6-trichlorpyridinol accounted for 72% of the total radiolabel in kidney, 81% in egg yolk, < 2% in liver, 65% in hydrolysed liver, 83% in skin, and 89% in fat.

The Meeting concluded that chlorpyrifos is metabolized in livestock to 3,5,6-trichloropyridinol and derivatives thereof, which are released by base hydrolysis. The Meeting also concluded that the residues are concentrated to a greater degree in fat than in muscle.

Plants

The metabolism of [^{14}C-2 and ^{14}C-6]chlorpyrifos was studied in leaves of *maize (corn), soya bean, and sugar beet.* A total of 24 maize plants were maintained in a chamber which permitted collection of volatile products, and radiolabelled chlorpyrifos was applied to the upper surfaces of the leaves as 1-µl drops up to a typical total dose of 200 µg of chlorpyrifos per plant. At intervals, the treated leaf areas were excised, rinsed with methanol, and analysed or homogenized in 75% acetone to extract metabolites. The untreated plant parts were also analysed to determine the extent of translocation as a function of time. The radiolabel that could be removed by rinsing with a solvent

decreased from 99% on the day of application to 1% on day 4, while the volatile radiolabel increased from 0 to 84% of the applied dose. The amount of translocated radiolabel did not represent more than 0.8% of the applied dose. The combined surface rinses and leaf extracts did not contain more than 10% of the applied dose 8–16 days after application, and the amount of radiolabel that could not be extracted did not exceed 3% of the applied dose. The extracts contained chlorpyrifos (0.1–0.4% of the applied dose) and polar metabolites. Acid hydrolysis, base hydrolysis, or enzyme hydrolysis of the extracts released 25–58% of the radiolabel in the extracts as 3,5,6-trichlorpyridinol.

Maize (field corn) was treated twice with radiolabelled chlorpyrifos, once by ground application at planting (223 mg ai/m of row) and again by foliar application (1.7 kg ai/ha). Green forage was harvested 49 days after the foliar application, and grain and fodder were harvested after 153 days. The concentrations of chlorpyrifos equivalents were 1.6 mg/kg in green forage, 4.2 mg/kg in dry fodder, and 0.13 mg/kg in grain. About 3% of the total residue in forage was chlorpyrifos, and 1% was 3,5,6-trichloropyridinol. Base hydrolysis of the green forage solubilized 90% of the total radiolabelled residue, and 30% was identified as 3,5,6-trichloropyridinol. A similar result was obtained with dry fodder, except that methoxy pyridine was tentatively identified as representing 3% of the residue. Corn forage was further characterized by sequential extraction as containing 17% polysaccharide, 10% hemicellulose, and 26% lignin. The residue in grain could not be released by mild base hydrolysis, but sequential extraction revealed 4% in protein, 14% in cellulose, 8% in gluten, and 34% in starch.

Soya beans were sprayed in mid-season with [^{14}C]chlorpyrifos at a rate of 1.12 kg ai/ha. Forage was sampled 14 days after treatment, and beans and field trash were sampled at the normal harvesting time 52 days after treatment. The forage was found to contain 46% of the total radiolabelled residue as chlorpyrifos and 24% as 3,5,6-trichloropyridinol, free and conjugated. The beans contained 2.6% of the residue as chlorpyrifos, 8.8% as free 3,5,6-trichloropyridinol, and 66% as incorporated (protein).

Sugar beets were given two applications of [^{14}C]chlorpyrifos in a manner analogous to the field corn. Green foliage was taken 38 days after the soil application and before the foliar application, and tops and mature beets were harvested 108 days after the foliar application. The green foliage contained primarily polar radiolabelled compounds, 90% of which were extractable. Alkaline hydrolysis of the extract released 3,5,6-tricholorpyridinol, representing 57% of the total residue. When mature beet tops were hydrolysed with base, 65% of the total radiolabel was released. About 29% of the radiolabel was associated with 3,5,6-trichloropyridinol. Solvent extraction of the tops released a mixture of polar compounds, accounting for 45% of the total residue. Methanol extraction of the beet roots released 85% of the residue. About 40% of the total residue was shown to be sucrose. Also present were methoxy pyridinol (7% of the total residue), 3,5,6-trichloropyridinol (36%), and chlorpyrifos (< 0.5%).

An *apple* tree was sprayed nine times with a wettable powder formulation of chorpyrifos, and in the last two applications [^{14}C]chlorpyrifos was admixed with unlabelled compound. The apples were harvested 14 days after the final treatment. Most of the radiolabel was found in the peel, with 0.8 mg/kg in peel and 0.005 mg/kg in flesh. In the peel, 36% of the residue was chlorpyrifos, 5.3% was free 3,5,6-trichloropyridinol, 1.2% was conjugated 3,5,6-trichloropyridinol, 5% was unknown compounds converted by refluxing base hydrolysis to 3,5,6-trichloropyridinol, and 15% was postulated to be natural products.

A study of confined rotational crops was conducted in which *carrots, lettuce,* and *wheat* were planted in soil treated with [^{14}C]chlorpyrifos 30 and 132 days after treatment. The concentrations of residue ranged from 0.19 mg/kg in carrot roots planted 30 days after treatment to 1.3 mg/kg in wheat straw planted after 132 days. In the carrot roots, chlorpyrifos represented 2.0% of the residue;

trichloropyridinol, 10%; trichloromethoxy-pyridine, 26%; and glucose, 21%. In wheat straw planted 30 days after treatment, trichloropyridinol represented 4.3% of the residue; cellulose, 13%; lignin, 17%; and glucose, 21%, In wheat grain: planted 30 days after treatment, the values were trichloropyridinol, 0.3%; cellulose, 8.5%; starch, 46%; and glucose, 49%. The identification of glucose was tentative.

The Meeting concluded that chlorpyrifos is metabolized to 3,5,6-trichloropyridinol, which is then conjugated or further degraded. Much of the chlorpyrifos is ultimately incorporated into natural components (such as protein, cellulose, and lignin) of the plants. The Meeting also concluded that chlropyrifos has a low to moderate tendency to translocate from the site of application.

Environmental fate

Under aerobic conditions in loam soil, chorpyrifos degraded to CO_2 over 360 days. The maximal concentration of 3,5,6-trichloropyridinol represented 4.3% of the applied dose at about day 60, and that of 3,5,6-trichloromethoxypyridine represented 1.6% at about day 30. The conversion was slower in clay soil. The degradation of 3,5,6-trichloropyridinol in soil involved extensive mineralization, with an average half-time of 73 days. Under anaerobic conditions in loam soil, 92% was converted to 3,5,6-trichloropyridinol over 360 days and none to 3,5,6-trichloromethoxypyridine.

Owing to its nonpolar nature, chlorpyrifos is sparsely soluble in water and tends to partition from aqueous into organic phases in the environment. It has a strong affinity for soil, as evidenced by an average soil and sediment sorption coefficient (K_{oc}) of 8500 ml/g (range, 970–31 000) in 28 laboratory studies in which the batch equilibrium method was used. 3,5,6-Trichloropyridinol has only a moderate affinity for sorption, with K_{oc} values of 18–390 ml/g (average, 160 ml/g).

30-cm glass columns packed with Commerce loam (0.68% organic carbon), Tracy sandy loam (1.1% organic carbon), or Catlin silty clay loam (2.0% organic carbon) which were treated with [^{14}C]chlorpyrifos at 0.5 kg/ha and eluted with 51 cm of water. Most of the chlorpyrifos (95–99%) remained in the top 2 cm of the column, and none moved beyond the upper 5 cm of soil. A maximum of 1.3% of the applied radiolabel appeared in the leachates. Field studies were conducted under natural conditions of rainfall and irrigation. Chlorpyrifos applied at 1.1–2.2 kg ai/ha remained in the top 20 cm of soil throughout the growing season. One of the studies indicated that 3,5,6-trichloropyridinol has at least a moderate tendency to leach. When chlorpyrifos was applied three times at 1.12 kg ai/ha during the growing season in a citrus grove, with a rainfall of 110 cm and irrigation with 48 cm, it was confined to the upper 15 cm of soil, but 3,5,6-trichloropyridinol was found at a depth of 46 cm.

The Meeting concluded that chlorpyrifos is converted in soil to 3,5,6-trichloropyridinol and ultimately to CO_2. The Meeting also concluded that chorpyrifos has no tendency to leach from the soil, but that the metabolite 3,5,6-trichloropyridinol has a moderate tendency to do so.

Methods of analysis

Methods for both enforcement and data collection and monitoring have been developed for the determination of chlorpyrifos in plant and animal matrices, soil, and water. Various extraction and clean-up methods are followed by analysis by gas chromatography with a flame photometric detector or, infrequently, an electron capture detector. Gas chromatography with mass spectrometry may be used for confirmation. A variation involves base hydrolysis of the matrix, which converts chlorpyrifos and conjugated 3,5,6-trichloropyridinol to 3,5,6-trichloropyridinol. The limit of determination is 0.01 mg/kg for methods for the determination of chlorpyrifos and 0.05 mg/kg for those for 3,5,6-trichloropyridinol.

The Meeting concluded that adequate analytical methods are available for the enforcement of MRLs and for monitoring.

Stability of residues in stored samples

Substantial data were made available on the stability of chlorpyrifos in frozen crop matrices. Generally, no loss occurred over 360 days of frozen storage, except from walnuts and almonds (20–23% loss within 258 days), oranges and orange juice (20% loss within 170 days), sorghum silage (23% loss within 65 days), and sugar beet roots (37% loss within 150 days).

Only summary information was provided on the stability of chlorpyrifos in animal commodities. The data for muscle, liver, and kidney were variable. In subcutaneous fat, 60–86% of the incurred residue remained after 41 months of frozen storage. About 74% of chlorpyrifos added at 0.1 or 1.0 mg/kg to whole milk remained after 49 months of frozen storage.

The Meeting concluded that chlropyrifos is stable in crop matrices stored frozen for up to 1 year. Insufficient detail was provided on animal commodities.

Definition of the residue

The studies on animals and plant metabolism and on environmental fate indicate that use of chlorpyrifos could result in the presence of the parent compound and the major metabolite 3,5,6-trichloropyridinol (free and conjugated) in agricultural commodities. The 1999 Meeting considered the trichloropyridinol metabolite during its deliberations, but established an ADI and an acute RfD only for the parent compound. Analytical methods for enforcement purposes are available for the determination of chlorpyrifos residues in plant and livestock commodities, soil, and water.

The octanol/water partition coefficient for chlorpyrifos, log P_{ow} = 4.7, indicates a tendency to prefer non-aqueous media, i.e., that chlorpyrifos is fat-soluble. This conclusion is confirmed by the results of studies in goats and poultry, in which the concentration of radiolabelled material in fat was up to 10 times that in muscle.

The Meeting concluded that the residue definition for both compliance with the MRL and estimation of dietary intake should be chlorpyrifos and that chlorpyrifos should be designated as fat-soluble.

Results of supervised trials

The results of supervised trials were provided for citrus (mandarin, orange, grapefruit, lemon), apple, pear, peach, plum, blueberry, caneberry, strawberry, grape, banana, kiwifruit, broccoli, Brussels sprout, cabbage, Chinese cabbage, cauliflower, pepper, tomato, soya, pea, carrot, potato, onion, lettuce, common bean, sugar beet, maize (corn), sweet corn, grain sorghum, rice, wheat, alfalfa, almond, pecan, peanut, sunflower, and coffee.

Data on the relevant GAP were not available to evaluate the data on blueberry, eggplant, and leaf lettuce. The percent moisture was not available for any of the animal feed commodities, such as alfalfa, and the default values for dry matter from the *FAO Manual* (FAO, 1997) were used to estimate MRLs on a dry-weight basis, where appropriate.

The results of five field trials on *mandarin orange* conducted according to GAP were presented from Spain (0.10 kg ai/hl, 3 kg ai/ha, 21-day PHI), in which the residue concentrations were: 0.15, 0.33, 0.55, 0.99, and 1.2 mg/kg. Five trials on *oranges* were reported from South Africa at GAP (0.048 kg ai/hl, 60-day PHI), showing concentrations of 0.05, 0.12, 0.14, 0.19, and 0.21 mg/kg. In

three trials from the USA (GAP, 0.7 kg ai/hl, 6.7 kg ai/ha foliar treatment, 35-day PHI; 0.5 kg ai/hl, 1.1 kg ai/ha, ground treatment, 28-day PHI), the concentrations were 0.26 (foliar), 0.41 (foliar), and 0.66 mg/kg (foliar and ground). One trial on *grapefruit* from Spain showed a concentration of 0.10 mg/kg. Trials on citrus fruit from Italy and the USA were not conducted according to GAP and were not evaluated further.

Thus, six trials at GAP values were available for small citrus (mandarin, lemon) and eight for large citrus (orange, grapefruit). The ranked order of concentrations of chlorpyrifos residues (median in italics) was: 0.05, 0.10, 0.12, 0.14, 0.15, 0.19, ***0.21***, ***0.26***, 0.33, 0.41, 0.55, 0.66, 0.99, and 1.2 mg/kg. The concentrations in small citrus and on large citrus were similar. No data were presented from analyses of pulp, but a study of orange processing showed a threefold reduction in the concentration between a whole orange and its pulp. Using this factor, the Meeting estimated a STMR value of 0.08 mg/kg for whole-fruit citrus pulp from the STMR value for whole citrus fruit (0.24/3). The Meeting estimated a HR value of 0.4 mg/kg for whole-fruit citrus pulp from the HR value for whole citrus fruit (1.2/3), and a maximum residue limit of 2 mg/kg for whole citrus.

One field trial on *apple* from Chile (GAP, 0.06 kg hl/hl, 28-day PHI) showed a concentration of 0.09 mg/kg, two from Italy (GAP, 0.053 kg ai/hl, 30-day PHI) gave values of 0.17 and 0.19 mg/kg, two from New Zealand (GAP, 0.025–0.038 kg ai/hl, 1 kg ai/ha minimum, 14-day PHI) gave values of 0.16 and 0.19 mg/kg, six trials from Germany (at the GAP of the United Kingdom of 0.96 kg ai/ha, 14-day PHI) showed concentrations of 0.08, 0.13, 0.17, 0.43, 0.53, and 0.94 mg/kg, and two from the United Kingdom resulted in values of 0.17 and 0.18 mg/kg. Trials were reported from Brazil, Canada, and the USA but were conducted according to GAP and were not evaluated further.

For *pear*, field trials were reported from Canada, the United Kingdom, and the USA, but no information on GAP was available, or the trials were not conducted at the GAP. As the GAP values for apple and pear in the United Kingdom are similar, the Meeting agreed to extrapolate the results for apples to pears and to estimate a STMR value and MRL for pome fruit. The ranked order of concentrations in the 13 trials for apples conducted according to GAP was: 0.08, 0.09, 0.13, 0.16. ***0.17*** (3 trials), 0.18, 0.19 (2 trials), 0.43, 0.53, and 0.94 mg/kg. The Meeting estimated a STMR value of 0.17 mg/kg, a HR value of 0.94 mg/kg, and a maximum residue level of 1 mg/kg. The latter replaces the existing MRLs for apples and pears.

Supervised field trials on *peach* were conducted in Chile (14 trials at the GAP of 0.06 kg ai/hl, 45-day PHI), with concentrations of 0.017, 0.023, 0.03, 0.04 (4 trials), 0.045, 0.05, 0.07, 0.08, 0.09, 0.13, and 0.25 mg/kg), Greece (one trial at the GAP of 0.08 kg ai/hl, 20-day PHI) with a value of 0.33 mg/kg, Spain (one trial at the Greek GAP) showing a concentration of 0.04 mg/kg), Italy (two trials at the GAP of 0.054 kg ai/hl, 0.80 kg ai/ha, 30-day PHI) with values of 0.04 and 0.05 mg/kg, and the USA (four trials at the GAP of 0.36 kg ai/ha directed to trunk, 14-day PHI), which showed < 0.01 mg/kg, reflecting the non-foliar use pattern.

The ranked order of the concentrations of residues after foliar application in 18 trials was: 0.017, 0.023, 0.03, ***0.04*** (6 trials), ***0.045***, 0.05 (2 trials), 0.07, 0.08, 0.09, 0.13, 0.25, and 0.33 mg/kg. These values represent the whole fruit, including the pit. For the whole fruit, the Meeting estimated a STMR value of 0.042 mg/kg, a HR value of 0.33 mg/kg , and a maximum residue level of 0.5 mg/kg.

Supervised field trials on *plum* were submitted from Chile (three trials at the GAP of 0.06 kg ai/hl, 45-day PHI) with values of 0.002 (2 trials) and 0.005 mg/kg, Japan (two trials at the GAP of 0.025 kg ai/hl, 14-day PHI) with values of 0.03 and 0.05 mg/kg, and Germany (four trials at the GAP of the United Kingdom of 0.38 kg ai/hl, 0.96 kg ai/ha, 14-day PHI) with concentrations of 0.04, 0.08, 0.14, and 0.20 mg/kg. The ranked order of concentrations in the nine trials was: 0.002 (2 trials), 0.005, 0.03, ***0.04***, 0.05, 0.08, 0.14, and 0.20 mg/kg. These values represent the whole fruit, including the pit.

For the whole fruit, the Meeting estimated a STMR value of 0.04 mg/kg, a HR value of 0.2 mg/kg, and a maximum residue level of 0.5 mg/kg.

Seven trials on *blueberry* were reported from the USA, but no GAP was reported. The Meeting declined to estimate a STMR value or maximum residue level.

Eleven trials on *blackberry*, *boysenberry*, and *raspberry* were reported from the USA, but no GAP was reported. The results of two trials on raspberries were reported from the United Kingdom at the GAP of 0.14 kg ai/hl, 0.72 kg ai/ha,7-day PHI. The Meeting decided that the results of two trials (0.25 and 0.52 mg/kg) were insufficient for estimating a maximum residue level or a STMR value and recommended withdrawal of the existing MRL for red and black raspberries of 0.2 mg/kg.

Supervised field trials on *strawberry* were reported from the United Kingdom (eight trials at the GAP of 0.072 kg ai/hl, 0.72 kg ai/ha, 7-day PHI) showing concentrations of 0.04, 0.09 (2 trials), 0.10 (2 trials), 0.12, 0.14, and 0.15 mg/kg) and from the USA (three trials at the GAP of 0.30 kg ai/hl, 1.1 kg ai/ha, 21-day PHI) with values of 0.02, 0.04, and 0.07 mg/kg. The ranked order of the concentrations of residues in the 11 trials was 0.02, 0.04 (2 trials), 0.07, ***0.09*** (2 trials), 0.10 (2 trials), 0.12, 0.14, and 0.15 mg/kg. The Meeting estimated a STMR value of 0.09 mg/kg, a HR value of 0.15 mg/kg, and a maximum residue level of 0.3 mg/kg .

Supervised field trials on *grape* were available from France (10 trials at the GAP of 0.34 kg ai/ha, 21-day PHI) showing concentrations of 0.02, 0.04, 0.06, 0.07, 0.08 (2 trials), 0.10, 0.14, and 0.15 (2 trials) mg/kg, Italy (two trials at the GAP of 0.05 kg ai/hl, 30-day PHI) with concentrations of 0.02 and 0.04 mg/kg, Greece (two trials at the GAP of 0.065 kg ai/hl, 0.54 kg ai/ha, 28-day PHI) showing values of 0.09 and 0.32 mg/kg, and South Africa (two trials at the GAP of 0.036 kg ai/hl, 28-day PHI) with values of 0.13 and 0.17 mg/kg. The ranked order of concentrations in the 16 trials conducted at GAP was: 0.02 (2 trials), 0.04 (2 trials), 0.06, 0.07, ***0.08*** (2 trials), 0.09, 0.1, 0.13, 0.14, 0.15 (2 trials), 0.17, and 0.32 mg/kg. The Meeting estimated a STMR value of 0.085 mg/kg, a HR value of 0.32 mg/kg, and a maximum residue level of 0.5 mg/kg. Although trials were reported from the USA, none was at the GAP value.

The results of supervised trials on *banana* treated by foliar application were reported from Australia (one trial at the GAP of 0.1 kg ai/hl, 1.0 kg ai/ha, 14-day PHI) with a value of 0.03 mg/kg whole fruit and < 0.02 mg/kg pulp; South Africa (two trials at the GAP of 0.036 kg ai/hl, 28-day PHI) showing 0.07 mg/kg assuming 20% of banana is peel, 0.33 mg/kg of peel, and 0.01 mg/kg of pulp, < 0.01 mg/kg of pulp, no data on peel; and Spain (seven trials including five in glasshouses, at the GAP of 0.1 kg ai/hl, 21-day PHI) giving values of 0.37 (< 0.01 pulp), 0.48 (0.01 pulp), 0.75, 1.1 (2 trials), 1.6 (2 trials) mg/kg of whole fruit. Additional trials were reported on the use of plastic bags impregnated with chlorpyrifos, from Ecuador (one trial at the GAP of Colombia, 1%, 1 bag per season, PHI, about 12 weeks: 0.06 whole fruit, < 0.01 mg/kg of pulp), Costa Rica (five trials at the GAP of Colombia: 0.01, 0.02, 0.04, 0.05, and 0.13 mg/kg of whole fruit; < 0.01 (4 trials), 0.01 mg/kg of pulp), Honduras (two trials at the GAP of Colombia: 0.01 (2 trials) mg/kg of whole fruit; < 0.01 (2 trials) mg/kg of pulp), and the Philippines (two trials at the GAP of 1% , 1 bag/season, PHI, about 12 weeks: 0.13 and 0.21 mg/kg of whole fruit; 0.04 and 0.05 mg/kg of pulp).

The ranked order of concentrations of residues on whole bananas after bag treatment was: 0.01 (3 trials), 0.02, 0.04, 0.05, 0.06, 0.13 (2 trials), and 0.21 mg/kg. The ranked order of concentrations on whole bananas after foliar treatment was: 0.03, 0.07, 0.37, 0.48, 0.75, 1.1 (2 trials), and 1.6 (2 trials) mg/kg. The Meeting estimated a maximum residue level of 2 mg/kg. The ranked order of the concentrations in pulp samples after bag treatment was: < 0.01 (7 trials), 0.01, 0.04, and 0.05 mg/kg, whereas those in pulp samples after foliar treatment were 0.01 (4 trials) and 0.05 mg/kg . The Meeting estimated a STMR value of 0.01 mg/kg and a HR value of 0.05 mg/kg for banana pulp.

Four trials on *kiwifruit* were reported from New Zealand, conducted at the GAP of 0.025 kg ai/hl, 0.50 kg ai/ha, 14-day PHI, with concentrations of 0.26, 0.75, 1.0, and 1.9 mg/kg. The Meeting concluded that four trials were insufficient to estimate a STMR value, and recommended withdrawal of the existing MRL of 2 mg/kg.

Supervised trials on *onion* were reported from Greece (seven trials at the GAP of 0.3 kg ai/hl, 0.96 kg ai/hl when banded, 7- or 20-day PHI) with concentrations of < 0.01 (2 trials), 0.02 (2 trials), 0.03, and 0.05 (2 trials) mg/kg; and the United Kingdom (four trials at the GAP of 0.16 kg ai/hl, 0.96 kg ai/ha, 21-day PHI) with values of 0.04, 0.06, 0.07, and 0.08 mg/kg. One trial of application to seeds at the time of planting was reported from Canada, resulting in a concentration of 0.14 mg/kg. This trial represented a substantially different use, and the results were not used, even though they represent the maximum residue; however, one trial was considered insufficient to estimate a maximum residue level. The ranked order of concentrations in the 11 trials of foliar application at GAP was: < 0.01 (2 trials), 0.02 (2 trials), 0.03, ***0.04***, 0.05 (2 trials), 0.06, 0.07, and 0.08 mg/kg. The Meeting estimated a STMR value of 0.04 mg/kg, a HR value of 0.08 mg/kg, and a maximum residue level of 0.2 mg/kg. The latter replaces the existing MRL of 0.05* mg/kg.

Reports were submitted of eight trials on *broccoli* in the USA at the GAP of 1.1 kg ai/ha. The PHI is 21 days in California and Arizona and 30 days elsewhere; the Meeting agreed to consider the data from all states at the 21-day PHI. The ranked order of residue concentrations was: < 0.01 (3 trials), 0.01, 0.03, 0.05, 0.07, and 1.4 mg/kg. The latter value, from a trial in New Jersey, seemed excessive, but there was no indication of error in the trial conduct. The Meeting estimated a STMR value of 0.02 mg/kg, a maximum residue level of 2 mg/kg, and a HR value of 1.4 mg/kg .

One trial on *Brussels sprout* was submitted from the USA, but the application rate did not comply with GAP. The Meeting decided that there were insufficient data to estimate a maximum residue level or a STMR value.

Reports of supervised field trials on *cabbage* were available from South Africa (three trials at the GAP of 0.024 kg ai/hl, 7-day PHI) showing concentrations of 0.01, 0.21, and 0.22 mg/kg, the United Kingdom (five trials at the GAP of 0.72 kg ai/ha, 21-day PHI) with values of 0.01, 0.02, 0.10, 0.15, and 0.26 mg/kg, and the USA (15 trials at the GAP of 2.5 kg ai/ha at the time of planting, 1.12 kg ai/ha foliar treatment, 21-day PHI. The ranked order of concentrations of residues was: < 0.01 (3 trials), 0.01 (3 trials), 0.02, 0.03 (3 trials), 0.10, ***0.15*** (2 trials), 0.21, 0.22 (3 trials), 0.26 (2 trials), 0.4, 0.5, 0.71, and 0.94 mg/kg. The Meeting estimated a STMR value of 0.15 mg/kg, a HR value of 0.94 mg/kg, and a maximum residue level of 1.0 mg/kg. The latter is recommended to replace the existing MRL of 0.05* mg/kg. Trials reported from Brazil did not correspond to GAP.

Six trials on *Chinese cabbage* were reported from the United Kingdom at the GAP of 0.16 kg ai/hl, 0.96 kg ai/ha, 21-day PHI. The ranked order of the concentrations of residues was: 0.04 (2 trials), 0.17, 0.19, 0.34, and 0.60 mg/kg. The Meeting estimated a STMR value of 0.18 mg/kg, a HR value of 0.60 mg/kg, and a maximum residue level of 1.0 mg/kg. The latter confirms the existing MRL of 1 mg/kg.

Five trials on *cauliflower* were reported from the United Kingdom at the GAP of 0.96 kg ai/ha, 21-day PHI. The ranked order of concentrations was < 0.01 (3 trials), 0.01, and 0.02 mg/kg. The Meeting considered that the results of five trials were sufficient, as the residue values were low and showed little variation. The Meeting estimated a STMR value of 0.01 mg/kg, a HR value of 0.02 mg/kg, and a maximum residue level of 0.05 mg/kg. This replaces the existing MRL of 0.05* mg/kg.

Results for *peppers, sweet* were reported from Spain (three trials at the GAP of 0.1 kg ai/hl, 7-day PHI) with values of 0.37, 0.45, and 0.47 mg/kg and the USA (17 trials at the GAP of 1.12 kg ai/hl, 7-day PHI). The ranked order of concentrations was 0.01, 0.06, 0.10 (2 trials), 0.13, 0.14, 0.27 (2 trials), 0.30, ***0.37***, ***0.39***, 0.40, 0.45, 0.47, 0.48, 0.52, 0.60 (2 trials), 0.81, and 1.4 mg/kg. The Meeting estimated a STMR value of 0.38 mg/kg, a HR value of 1.4 mg/kg, and a maximum residue level of 2.0 mg/kg. The latter replaces the existing MRL of 0.5 mg/kg.

Reports of supervised field trials on *tomato* were provided from Australia (one trial at the GAP of 0.10 kg ai/hl, 3-day PHI) giving a value of 0.13 mg/kg, Brazil (one trial at the GAP of 0.72 kg ai/ha, 21-day PHI) showing a concentration of 0.03 mg/kg, Mexico (three trials at the GAP of 1 kg ai/ha, 1-day PHI) with concentrations of 0.06, 0.19, and 0.33 mg/kg, South Africa (two trials at the GAP of 0.1 kg ai/hl, 4-day PHI) with a value of 0.23 (2 trials) mg/kg, and Spain (two trials at the GAP of 0.1 kg ai/hl, 7-day PHI) with values of 0.06 and 0.08 mg/kg. The ranked order of concentrations was 0.03, 0.06 (2 trials), 0.08, *0.13*, 0.19, 0.23 (2 trials), and 0.33 mg/kg. The Meeting estimated a STMR value of 0.13, mg/kg, a HR value of 0.33 mg/kg, and a maximum residue level of 0.5 mg/kg. This confirms the existing MRL. Although trials were conducted in the USA, none conformd with GAP.

A report on one supervised trial on *eggplant* was received from Turkey, but no GAP was reported. The Meeting regarded the database as inadequate.

Reports on field trials on *head lettuce* were provided from Spain on *leaf lettuce* from the USA, but no information was provided on GAP. The Meeting declined to estimate STMR values or maximum residue levels, given the lack of data.

The results of supervised field trials on *common bean (snap and kidney)* were reported from Italy (three trials at the GAP of 0.53 kg ai/ha, foliar treatment, 15-day PHI) and the USA (four trials at the GAP of 0.62 g ai/kg, seed treatment). The ranked order of concentrations of residues after foliar treatment was < 0.01 (2 trials) and 0.05 mg/kg, and that after seed treatment was < 0.01 (2 trials) and 0.01 (2 trials) mg/kg. The Meeting concluded that three or four trials were an insufficient for estimating a maximum residue limit or STMR value. The results of seed treatment of peas (see below) were considered suitable for evaluating bean seed treatment. The ranked order of concentrations of residues of chlorpyrifos in common beans and peas with pods after seed treatment at 0.62 kg ai/kg of seed, was < 0.01 (3 trials) and 0.01 (5 trials) mg/kg. The Meeting estimated a HR value of 0.01 mg/kg, a maximum residue level of 0.01 mg/kg, and a STMR value of 0.01 mg/kg for common beans. The MRL would replace the existing MRL of 0.2 mg/kg.

The results of four supervised trials on *pea* that conformed to GAP were reported from the USA (GAP, 0.62 kg ai/kg of seed, seed treatment), resulting in a concentration of 0.01 mg/kg in all four trials. The results for seed treatment of common beans (see above) may be used to support the results for pea seed treatment. The ranked order of concentrations of residues of chlorpyrifos in common beans and peas with pods after seed treatment at 0.62 kg ai/kg seed was < 0.01 (3 trials) and 0.01 (4 trials) mg/kg. The Meeting estimated a HR value of 0.01 mg/kg, a maximum residue level of 0.01 mg/kg, and a STMR value of 0.01 mg/kg for peas with pods. Trials reported from the United Kingdom did not conform to GAP and were not considered.

Reports were received on supervised trials conducted on *soya* in Thailand (two trials at the GAP of 0.72 kg ai/ha, 7-day PHI) giving concentrations of 0.23 and 1.6 mg/kg and the USA (five trials at the GAP of 1.1 kg ai/ha, 28-day PHI) showing values of < 0.01 (2 trials), 0.01 (2 trials), and 0.05 mg/kg). The Thai and USA data represent different populations of residues and cannot be grouped. The Meeting concluded that five data values were insufficient to permit estimation of a maximum residue level or a STMR value.

Supervised trials were conducted on *carrot* in the Netherlands (two trials at the GAP of the United Kingdom of 0.96 kg ai/ha, 14-day PHI) giving values of 0.01 and 0.03 mg/kg, South Africa (one trial at the GAP of 0.48 kg ai/ha, 21-day PHI) showing a value of 0.05 mg/kg, and the United Kingdom (three trials) resulting in concentrations of < 0.01, 0.02, and 0.03 mg/kg. The ranked order of concentrations of residues found in the six trials was < 0.01, 0.01, ***0.02***, ***0.03*** (2 trials), and 0.05 mg/kg. The Meeting estimated a STMR value of 0.025 mg/kg, a HR value of 0.05 mg/kg, and a maximum residue level of 0.1 mg/kg. The latter replaces the existing MRL of 0.5 mg/kg.

Reports were available for supervised trials of ground application to *potato* at the time of planting in Brazil (four trials at the GAP of Argentina of 3 kg ai/ha) with residue concentrations of 0.02, 0.13, 0.29, and 0.51 mg/kg. Data were also provided from trials of foliar and planting plus foliar treatment from Australia (two trials at the GAP of 3 kg ai/ha before planting, 0.5 kg ai/ha at hilling up) showing a value of < 0.01 mg/kg in both trials, Brazil (one trial at the GAP of 0.72 kg ai/ha, 21-day PHI) with a value of 0.01 mg/kg, Canada (one trial at the GAP of 0.48 kg ai/ha for emulsifiable concentrate, 7-day PHI) with a value of 0.01 mg/kg, and Poland (one trial at the GAP of 0.42 kg ai/ha, 30-day PHI) showing < 0.02 mg/kg. The ranked order of concentrations in the five trials of foliar residues was: < 0.01 (2 trials), 0.01 (2 trials), and < 0.02 mg/kg. The ranked order in the four trials of ground application at the time of planting was 0.02, 0.13, 0.29, and 0.51 mg/kg. The Meeting concluded that neither data set contained an adequate number of values for estimating a maximum residue level or a STMR value. The Meeting also recommended withdrawal of the existing MRL of 0.05* mg/kg. Trials reported from Colombia, South Africa, and the United Kingdom were not conducted according to GAP and not evaluated.

Supervised trials on *sugar beet* were conducted in Canada (one trial at the GAP of 1.2 kg ai/ha for foliar application, 90-day PHI) showing a residue concentration of < 0.01 mg/kg, France (one trial at the GAP of 1.5 kg ai/ha before planting) with a value of < 0.01 mg/kg, and the USA (eight trials at the GAP of 1.1 kg ai/ha for foliar application, 30-day PHI) with values of 0.01 (4 trials), 0.02 (3 trials), and 0.03 mg/kg). The ranked order of concentrations of residues in the nine trials of roots after foliar treatment was: < 0.01, ***0.01*** (4 trials), ***0.02*** (3 trials), and 0.03 mg/kg. The Meeting estimated a STMR value of 0.015 mg/kg, a HR value of 0.03 mg/kg, and a maximum residue level of 0.05 mg/kg. The latter replaces the existing MRL of 0.05* mg/kg. Trials from Germany and the United Kingdom did not comply with GAP, and although trials were reported from Japan, no GAP was reported.

Supervised field trials on *maize* were reported for application at the time of planting in Brazil (two trials at the GAP of Argentina of 1.9 kg ai/ha, incorporated into soil) both showing < 0.01 mg/kg). Trials from the USA were not conducted at the GAP. Trials were also reported for foliar application or preplanting plus foliar application in Brazil (one trial at the GAP of 0.48 kg ai/ha, 2-day PHI) with a value of < 0.01 mg/kg and the USA (seven trials at the GAP of 3.4 kg ai/ha before planting, 1.7 kg ai/ha for foliar treatment, 35-day PHI for grain and fodder, 14-day PHI for silage. The ranked order of the concentrations of residues in grain after foliar application was: < 0.01, 0.01 (3 trials), 0.02, 0.03 (2 trials), and 0.04 mg/kg. The Meeting estimated a STMR value of 0.015 mg/kg and a maximum residue level of 0.05 mg/kg.

Supervised field trials were conducted on *sweet corn* in Canada (one trial at the GAP of 1.15 kg ai/ha, 70-day PHI) and the USA (six trials at the GAP for grain and 10 at the GAP for forage of 3.4 kg ai for emulsifiable concentrate before planting and 1.7 kg/ai for foliar emulsifiable concentrate, 2.3 kg ai for granular formulation before planting and 1.1 kg/ai for foliar treatment, 35-day PHI for grain and fodder, 14-day PHI for silage). The concentration of residues in grain was < 0.01 mg/kg in all seven trials. Information was also supplied on seed treatment in the USA (seven trials at the GAP of 62 g ai/100 kg of seed, wettable powder). The concentration was < 0.01 mg/kg in all five trials. In two trials, results were not reported for kernel with cob. On the basis of the values after foliar application,

the Meeting estimated a STMR value of 0.01 mg/kg, a HR value of 0.01 mg/kg, and a maximum residue level of 0.01* mg/kg.

Trials of use of chlorpyrifos in *rice* were reported from Australia, Colombia, India, the Philippines, Thailand, and Viet Nam, but none was at the relevant GAP. As no data were available on treatment of rice under GAP conditions, the Meeting decided that the database was inadequate for estimating either a STMR value or a maximum residue level. The Meeting further recommended withdrawal of the existing MRL of 0.1 mg/kg.

Supervised field trials on *sorghum* were reported from Brazil (one trials at the GAP of 0.36 kg ai/ha, 21-day PHI) showing a residue concentration of 0.07 mg/kg, and the USA (six trials at the GAP of 1.1 kg ai/ha, emulsifiable concentrate, 60-day PHI; 2 kg ai/ha of granular formulation at the time of planting). The ranked order of concentrations was: < 0.01 (2 trials), 0.02, ***0.04***, 0.07, 0.20, and 0.27 mg/kg. The Meeting estimated a STMR value of 0.04 mg/kg and a maximum residue level of 0.5 mg/kg. Two trials from Australia did not comply with GAP and were discarded.

Supervised field trials on *wheat* were reported from Brazil (three trials at the GAP of 0.72 kg ai/ha, 21-day PHI) with values of 0.04, 0.06, and 0.30 mg/kg and the USA (17 trials at the GAP of 0.56 kg ai/ha, 28-day PHI for grain, 14-day PHI for forage or hay). The ranked order of the concentrations of residues after use on grain were: < 0.01 (3 trials), ***0.01*** (7 trials), ***0.02*** (3 trials), 0.03, 0.04, 0.05, 0.06, 0.19, 0.23, and 0.30 mg/kg. The Meeting estimated a STMR value of 0.015 mg/kg and a MRL of 0.5 mg/kg. Trials from Canada and the United Kingdom were not in accordance with GAP in those countries, and although trials were reported from germany no GAP was provided.

Supervised trials on *almond* were conducted in the USA (three trials at the GAP of 2.2 kg ai/ha for foliar application, 4.5 kg ai/ha for ground application, 14-day PHI; four trials at the GAP of 2.2 kg ai/ha for dormant crop). The ranked order of the concentrations in almond nutmeat was: < 0.01, 0.01 (2 trials), **< *0.05*** (3 trials), and 0.05 mg/kg. The highest concentration resulted from the use on dormant crop. The two uses are distinguished by the PHI, 14 days versus about 180 days for use on dormant crop (with no nuts). As metabolic studies showed that chlorpyrifos is not readily translocated, any residues on almond nutmeat probably result from contamination during removal of the shells. The Meeting estimated a STMR value of 0.05 mg/kg, a HR value of 0.05 mg/kg, and a maximum residue level of 0.05 mg/kg.

Supervised trials on *pecan* were conducted in the USA (eight trials at the GAP of 2.2 kg ai/ha for foliar application, 28-day PHI). The ranked order of the concentrations of residues on the nutmeat was: < 0.01 (2 trials) and < 0.05 (6 trials). The latter value resulted from use of a method to determine combined residues of chlorpyrifos and 3,5,6-trichloropyridinol. The Meeting estimated a STMR value of 0.05 mg/kg, a HR value of 0.05 mg/kg, and a maximum residue level of 0.05* mg/kg.

Six supervised trials were conducted on *walnut* in the USA (at the GAP of 2.24 kg ai/ha, 14-day PHI). The concentration of residues on the nutmeat was < 0.05 mg/kg in all six trials. The Meeting estimated a STMR value of 0.05 mg/kg, a HR value of 0.05 mg/kg, and a maximum residue level of 0.05* mg/kg.

Supervised field trials were conducted on *cottonseed* in Brazil (two trials at the GAP of 0.96 kg ai/ha, 21-day PHI: 0.02 and 0.07 mg/kg) and the USA (three trials at the GAP of 1.1 kg ai/ha, 14-day PHI). The ranked order of concentrations of residues in cottonseed was: 0.02, 0.07, 0.16, 0.17, and 2.0 mg/kg. The Meeting concluded that five values was an insufficient number for estimating a STMR value or a maximum residue level. The Meeting further recommended the withdrawal of the existing MRL of 0.05* mg/kg

The results of a supervised field trials on *peanut* conducted in the USA at the GAP of 2.2 kg ai/ha, 21-day PHI were available. The Meeting concluded that the data were insufficient to estimate a STMR value or a maximum residue level.

A supervised field trial was conducted on *sunflower* in the USA at the GAP of 2.2 kg ai/ha before planting, 1.7 kg ai/ha foliar, 42-day PHI. A trial in Canada did not comply with GAP. The Meeting concluded that the data were insufficient to estimate a STMR value or a maximum residue level.

The results of supervised field trials on *coffee* were reported from Brazil (five trials at the GAP of 0.72 kg ai/ha, 21-day PHI) and the United Republic of Tanzania (one trial at the GAP of 0.96 kg ai/ha, 7-day PHI) with a residue concentration of 0.04 mg/kg. Two trials conducted in Colombia did not comply with GAP.The ranked order of concentrations of residues was: 0.01 (3 trials), ***0.03*** (2 trials), and 0.04 mg/kg. The Meeting estimated a maximum residue level of 0.05 mg/kg, a STMR value of 0.03 mg/kg, and a HR value of 0.04 mg/kg.

Supervised trials were conducted on *alfalfa* in the USA, where the GAP specifies tiered application rates and PHIs: 0.28 kg ai/ha, 7-day PHI; 0.56 kg ai/ha, 14-day PHI; and > 0.56–1.12 kg ai/ha, 21-day PHI. Additionally, a specific GAP applies to California and Arizona: 0.56 kg ai/ha, 4-day PHI. In all cases, only one foliar application may be made per cutting cycle, and the maximum number of applications is four per season. Of the trials reported, 29 confomed to GAP. The ranked order of concentrations of residues in green alfalfa forage was: < 0.01, 0.01, 0.06 (2 trials), 0.08, 0.12, 0.17, 0.20, 0.21, 0.22, 0.25, 0.27, 0.30, 0.38, ***0.42***, 0.43 (2 trials), 0.45, 0.57, 0.62, 0.65, 0.89, 0.90, 1.3, 1.4, 1.5, 2.2, 2.7, and 5.6 mg/kg (fresh weight). As the moisture contents were not determined, the Meeting used the value given in the *FAO Manual* (FAO, 1997) of 35% dry matter. The Meeting estimated a STMR value of 1.2 mg/kg (0.42/0.35) and a maximum residue level of 20 mg/kg (5.6/0.35 = 16).

The ranked order of the concentrations of residues in the 28 trials on alfalfa hay was: 0.02, 0.04 (2 trials), 0,28, 0.35, 0.36, 0.43 (2 trials), 0.45, 0.46, 0.59, 0.63, 0.64, ***0.66***, ***0.78***, 0.92, 0.93, 1.0, 1.1, 1.2 (2 trials), 1.3, 1.7, 1.8 (2 trials), 2.0, 2.3, and 2.6 mg/kg (fresh weight). One value of 12 mg/kg for hay was discarded. In numerous comparative trials of the emulsifiable concentrate and water-dispersible granule formulations, the concentrations of residue were comparable within a factor of 2. However, in the case in which the emulsifiable concentrate yielded 12 mg/kg, the water-dispersible granule formulation yielded 1.8 mg/kg. Using the value for moisture in the *FAO Manual* of 89% dry matter, the Meeting estimated a STMR value of 0.81 mg/kg (0.72/0.89) and a maximum residue level of 5 mg/kg (2.6/0.89 = 2.9).

Three supervised trials on *almond hull* were conducted in the USA at the GAP of 2.2 kg ai/ha for foliar application, 4.5 kg ai/ha for ground application, 14-day PHI. The ranked order of concentrations in almond hulls was: 1.9, 2.3, and 3.2 mg/kg. The Meeting estimated a STMR value of 2.3 mg/kg and a HR value of 3.2 mg/kg.

Supervised trials of residues in *green pea vine* after seed treatment were reported from the USA (four trials at the GAP of 0.62 kg ai/kg of seed). The ranked order of concentrations of residues on pea vines was: 0.01, 0.02 , 0.05, and 0.17 mg/kg**.** These data are comparable to those for common bean vines: 13 trials, six at the GAP of 0.62 g ai/kg, water-dispersible granule; ranked order of concentrations of residues: < 0.01 (2 trials), 0.01, 0.03, 0.05, and 0.06 mg/kg. The ranked order in the combined database was < 0.01 (2 trials), 0.01 (2 trials), ***0.02***, ***0.03***, 0.05 (2 trials), 0.06, and 0.17 mg/kg. As no data were provided on the moisture content of the vines, the value in the *FAO Manual*, 25% dry matter, was used. The Meeting estimated a STMR value of 0.10 mg/kg (0.025/0.25) and a maximum residue limit of 1 mg/kg (0.17/0.25 = 0.68), both for dry weight.

Reports were available from supervised trials on *soya forage and hay* in Thailand (two trials at the GAP of 0.72 kg ai/ha, 7-day PHI) and the USA (six trials at the GAP of 1.1 kg ai/ha, 28-day PHI). One value was reported from the USA for green forage, 0.38 mg/kg. Additional data were supplied for straw, which is not a commodity listed by Codex. The Meeting declined to estimate STMR values or maximum residue levels for forage and hay.

Supervised trials of residues in *sugar-beet top and leaf* after foliar application or preplanting plus foliar application to sugar beets were conducted in Canada (one trial at the GAP of 1.2 kg ai/ha, 90-day PHI) with a residue concentration of < 0.01 mg/kg and the USA (eight trials at the GAP of 2.3 kg/ai of granular formulation at the time of planting, 1.1 kg ai/ha for foliar application, 30-day PHI). Although trials were reported from Japan, no GAP was reported, and of trials carried out in the United Kingdom, none was at the GAP. The results of trials of application of chlorpyrifos to soil before or at the time of planting were reported from France (one trial at the GAP of 1.5 kg ai/ha before planting, with a concentration of < 0.01 mg/kg. None of the trials from Germany was at the GAP. The ranked order of concentrations of residues in samples of tops after foliar application was: < 0.01, 0.15, 0.42, 0.44, ***0.68***, 1.3, 1.4, 3.1, and 6.6 mg/kg. As no information was provided on the moisture content, the value in the *FAO Manual,* 23% of dry matter, was used. The Meeting estimated a STMR value of 3.0 mg/kg (0.68/0.23) and a maximum residue level of 40 mg/kg (6.6/.23 = 28.6), both on a dry weight basis.

Supervised field trials were reported of residues on *maize (field corn) fodder and forage* after application at the time of planting of maize in Brazil (two trials at the GAP of Argentina of 1.9 kg ai/ha, incorporated into soil), but with no data on fodder or forage. Of six trials in the USA, none was at the GAP). Additional trials were reported of early-to-late seasonal foliar application of chlorpyrifos to maize in Brazil (one trials at the GAP of 0.48 kg ai/ha, 21-day PHI; no data on forage or fodder) and the USA (seven trials at the GAP of 3.4 kg ai/ha before planting, 1.7 kg ai/ha for foliar application, 35-day PHI for grain and fodder, 14-day PHI for silage).

The ranked concentrations of residues in fodder were: 1.6, 1.7, 2.0, *2.3*, 3.1, 5.9, and 7.2 mg/kg. As no data were provided on moisture content, the value in the *FAO Manual* (Appendix IX) for stover of 83% of dry matter was used. The ranked order on a dry weight basis was: 1.9, 2.0, 2.4, ***2.8***, 3.7, 7.1, and 8.7 mg/kg. The Meeting estimated a maximum residue level of 10 mg/kg and a STMR value of 2.8 mg/kg for maize fodder, both of a dry weight basis**.**

The ranked concentrations of residues in maize forage were: 2.1, 2.8, *3.0*, *3.6*, 5.5, and 7.2 mg/kg. As data on moisture content were not available, the value in the *FAO Manual* (Appendix IX) of 40% of dry matter was used. The ranked order of concentrations on a dry-weight basis was 5.2, 7.0, ***7.5***, ***9.0***, 14, and 18 mg/kg. The Meeting estimated a STMR value of 8.2 mg/kg and a maximum residue level of 20 mg/kg, both for dry-weight.

Supervised field trials on residues in *sweet corn fodder (stover) and forage* after treatment of sweet corn were conducted in Canada (one trial at the GAP of 1.15 kg ai/ha, 70-day PHI, no data on forage or fodder) and the USA (six trials at the GAP for grain, 10 at the GAP for forage, and seven at the GAP for fodder of 3.4 kg ai of emulsifiable concentrate before planting, 1.7 kg/ai for foliar application of emulsifiable concentrate, 2.3 kg ai of granular formulation before planting, and 1.1 kg/ai for foliar application, respectively; 35-day PHI for grain and fodder, 14-day PHI for silage). The ranked order of concentrations in forage was: 0.11 (2 trials), 0.24, 0.38, 0.64, 0.81, 1.1, 1.2 (2 trials), and 3.4 mg/kg. As data on moisture content were not available, the value in the *FAO Manual* (Appendix IX), 48% of dry matter, was used to arrive at the following ranked order (dry-matter basis): 0.23 (2 trials), 0.50, 0.79, ***1.3***, 1.7, 2.3, 2.5 (2 trials), and 7.1 mg/kg. The Meeting agreed that sweet

corn forage represented a different population from maize forage and considered that the STMR value and maximum residue limit for maize forage would suffice for sweet corn forage.

Seven values were available for concentrations of residues in sweet corn fodder (stover), ranked as follows: 0.06, 0.14, 0.16, 0.23, 0.77, 1.3, and 1.6 mg/kg. As data on moisture content were not available, the value in the *FAO Manual* (Appendix IX) for the moisture content of stover, 83% of dry matter, was used to arrive at the following ranked order of values (dry-matter basis): 0.07, 0.17, 0.19, ***0.28***, 0.93, 1.6, and 1.9 mg/kg. The Meeting agreed that sweet corn stover represents a different population from maize fodder and considered that the MRL and STMR value for maize fodder would suffice for sweet corn fodder (stover).

Supervised field trials of the residues in *sorghum forage and fodder* after treatment of sorghum were reported from Brazil (one trials at the GAP of 0.36 kg ai/ha, 21-day PHI; no data on fodder) and the USA (six trials at the GAP of 1.1 kg ai/ha, emulsifiable concentrate, 60-day PHI; 2 kg ai/ha of granular formulation at the time of planting). Two trials from Australia did not comply with the GAP. The ranked order of concentrations was: 0.01, 0.08, ***0.17***, ***0.34***, 0.39, and 1.3 mg/kg. Using the value in the *FAO Manual* (Appendix IX) for water content, 88% of dry matter, the Meeting estimated a STMR value of 0.29 mg/kg (0.255/0.88), and a maximum residue limit of 2 mg/kg (1.3/0.88 = 1.5).

Only four values were available for residues in green forage, ranging from 0.01 to 0.14 mg/kg, and the Meeting concluded that this was an insufficient database for estimating a STMR or HR value.

The results of supervised field trials of residues in *wheat forage and straw* after treatment of wheat were reported from Brazil (three trials at the GAP of 0.72 kg ai/ha, 21-day PHI; no data on forage) and the USA (19 trials at the GAP of 0.56 kg ai/ha, 28-day PHI for grain, 14-day PHI for forage and hay). Trials from Canada and the United Kingdom were not conducted at the GAP, and for one trial from Germany no GAP was reported. The ranked order of concentrations was: 0.01, 0.03, 0.09, 0.11, 0.2, 0.39, 0.47, ***0.48*** (2 trials), ***0.60***, 0.63, 0.64, 0.96, 1.2 (2 trials), 2.1, 2.2, and 4.1 mg/kg. Using the value of 88% of dry matter from the *FAO Manual* (Appendix IX), the Meeting estimated a STMR value of 0.54 mg/kg (0.48/0.88) and a maximum residue limit of 5 mg/kg (4.1/0.88 = 4.6), both on a dry-weight basis.

No studies that were conducted in accordance with GAP were provided for green forage.

Fate of residues during processing

The Meeting received data on the fate of incurred residues of chlorpyrifos during the processing of apples, citrus, grapes, tomatoes, soya beans, maize (corn), rice, sorghum, wheat, cotton, peanuts, sunflower, and coffee. MRLs were not estimated for cotton, peanuts, soya beans, sunflower, or coffee, and these studies are not considered further. Moreover, a study in which fortified sugar beets as opposed to incurred residues were used was considered inappropriate.

Apples with an average residue concentration of 3.2 or 0.53 mg/kg were processed into juice, wet pomace, and dry pomace, with average concentration factors of 0.15, 2.0, and 6.6, respectively. The factors for juice and dry pomace applied by the Meeting to the STMR value for apple (0.18) yield STMR-P values of 0.027 mg/kg for juice and 1.2 mg/kg for dry pomace. The HR value for apple, 0.94 mg/kg, yields HR-P values of 6.2 mg/kg for dry apple pomace and 1.9 mg/kg for wet apple pomace.

Oranges bearing residues of chlorpyrifos were processed into orange juice in eight studies in which home processing was simulated. The processing factors ranged from 0.02 to 0.06. Single studies of commercial processing were conducted with oranges, *grapefruit*, *lemons*, and *tangelos*, in which the processing factor were 0.02–0.03. The average processing factor for the 12 studies was 0.03. By

applying the factor to the median concentration for whole citrus (0.24) and to the maximum residue on whole citrus (1.2 mg/kg), the Meeting estimated the STMR-P value to be 0.007 mg/kg for juice.

Oranges, grapefruit, lemons, and tangelos with incurred residues of chlorpyrifos were processed commercially into juice, dried pulp, and oil. The processing factors for pulp were 3.8 for grapefruit, 1.5 for lemons, 2.6 for oranges, and 4.0 for tangelos, with an average of 3.0. The respective processing factors for oil were 22, 3.2, 6.4, and 13, with an average of 9. With the average processing factor for citrus oil, the median residue for whole citrus (0.24 mg/kg) and the HR value for whole citrus (1.2 mg/kg), the STMR-P value for citrus oil is 2.2 mg/kg and the HR value is 11 mg/kg. With the average processing factor for citrus pulp, the HR value for whole citrus (1.2 mg/kg), and the median residue for whole citrus (0.24 mg/kg), the HR value for dried citrus pulp was estimated by the Meeting to be 3.6 mg/kg and the STMR-P value to be 0.72 mg/kg.

When *grapes* with concentrations of incurred residues of chlorpyrifos of 1.3 or 0.38 mg/kg were sun-dried, the processing factors for raisins were 0.22 and 0.20 (average, 0.21). The Meeting applied this average factor to the HR and STMR values for grapes (0.32 and 0.08 mg/kg) and estimated a HR value of 0.07 mg/kg and a STMR-P value of 0.017 mg/kg for raisins. The Meeting also estimated a maximum residue level of 0.1 mg/kg for raisins.

Grapes containing chlorpyrifos at 0.48 mg/kg were processed into juice, with a processing factor of 0.06. Using the STMR value for grapes (0.08 mg/kg), the Meeting estimated a STMR-P value of 0.005 mg/kg for juice.

In studies in France, Israel, and Italy in which grapes were processed into wine, the processing factor ranged from 0.006 to 0.3, with an average of 0.08. The wide range may be due to the absence of quantifiable residue in the wine (< 0.01 mg/kg). The Meeting applied the average factor to the STMR value for grapes (0.08 mg/kg) to estimate a STMR-P value for wine of 0.007 mg/kg.

Tomatoes were processed into juice and tomato paste in a study in Israel and into juice and puree in a study in the USA. The processing factors for juice ranged from 0.03 to 0.4 ($\nu = 9$; average, 0.18 or 0.2). The processing factor for puree was 0.1, and those for paste ranged from 0.08 to 0.3 ($\nu = 8$; average, 0.16 or 0.2). Using the average processing factors and the STMR value for tomatoes (0.13 mg/kg), the Meeting estimated STMR-P values of 0.026 mg/kg for tomato paste and juice.

Corn (maize) with an incurred residue of 0.04 mg/kg was processed by both wet and dry milling in the USA. The processing factors for dry milling were 1.2 for meal, 1.8 for flour, and 1.5 for crude and refined oil. Those for wet milling were 3 for crude oil and 3.2 for refined oil. The Meeting decided to use the processing factor for wet milling of oil. Using the STMR value for corn grain (0.01 mg/kg), the Meeting estimated the following STMR-P values: meal, 0.01 mg/kg; crude oil, 0.03 mg/kg; refined oil, 0.03 mg/kg; and milled by-products, 0.02 mg/kg based on flour. The Meeting also estimated a maximum residue level of 0.2 mg/kg for refined oil and a HR-P value of 0.09 mg/kg for milled by-products, on the basis of the factor of 1.8 for flour.

Sorghum grain bearing chlropyrifos residue at 0.04 mg/kg was milled into flour in the USA, with a processing factor of 0.2. Using the sorghum grain STMR value of 0.04 mg/kg, the Meeting estimated a STMR-P value of 0.008 mg/kg for sorghum flour.

Wheat grain with an incurred concentration of chlropyrifos residue of 0.51 mg/kg was milled in the USA into bran, flour, shorts, and milled by-products, with processing factors of 2.5, 0.2, 2.4, and 2.5. Using the STMR value for wheat grain (0.01 mg/kg), the Meeting estimated the following STMR-P values: bran, 0.03 mg/kg; flour, 0.002 mg/kg; shorts, 0.03 mg/kg; and milled by-products, 0.03 mg/kg. The Meeting also estimated a maximum residue level of 0.1 mg/kg for wheat flour. Using

the HR value of wheat, 0.30 mg/kg, the Meeting estimated a HR-P value for wheat milled by-products of 0.75 mg/kg.

Coffee beans (shelled and dried) with incurred residues of chlorpyrifos were roasted in trials in Brazil and Colombia. The processing factors were 0.5 and 0.1 in Brazil and 0.5 and 0.25 in Columbia (average factor, 0.34). Application of this factor to the STMR value for coffee (0.03 mg/kg) yields a STMR-P value of 0.01 mg/kg for roasted coffee beans.

Residues in animal and poultry commodities

The Meeting estimated the dietary burden of chlorpyrifos in farm animals and poultry on the basis of the diets listed in Appendix IX of the *FAO Manual.* Calculation from the MRLs yields maximum theoretical dietary intakes, or the concentrations of residues in feed suitable for estimating MRLs for animal commodities. Calculation from STMR values for feed allows estimation of STMR values for animal commodities. The diets are designed to maximize dietary intake of chlorpyrifos, and nutritional requirements are not taken into consideration.

Maximum theoretical dietary burden

Commodity	Maximum residue level	Group	% dry matter	Percent of diet				Concentration of residue (mg/kg)			
				Beef cattle	Dairy cows	Poultry	Pigs	Beef cattle	Dairy cows	Poultry	Pigs
Alfalfa forage (green)	20	AL	100	70	60			14	12		
Alfalfa hay	5	AL									
Almond hulls	3.2	–	90								
Apple pomace, wet	6.2	AB	40								
Citrus pulp, dried	3.6	AB	91								
Maize	0.05	GC	88								
Maize forage	20	AF	100	10	30			2	6		
Maize fodder	10	AS	100								
Maize, milled by-products	0.09	–	85								
Pea vines (green)	1	AL	100								
Sorghum	0.5	GC	86			50	50			0.29	0.29
Sorghum stover (fodder)	2	AS	100								
Sugar beet, tops	40	AV	100	20	10			8	4		
Wheat	0.5	GC	89								
Wheat, milled by-products	0.75	–	88			50	50			0.43	0.43
Wheat, straw	5	AS	100								
Total				100	100	100	100	24	22	0.77	0.77

Average dietary burden

Commodity	STMR/ STMR-P	Group	% dry matter	Percent of diet				Concentration of residue (mg/kg)			
				Beef cattle	Dairy cows	Poultry	Pigs	Beef cattle	Dairy cows	Poultry	Pigs
Alfalfa forage (green)	1.2	AL	100								
Alfalfa hay	0.81	AL									
Almond hulls	2.3	AL	90	10	10			0.26	0.26		
Apple pomace, wet	0.34	AB	40	25	25			0.21	0.21		
Citrus pulp, dried	0.72	AB	91								
Maize	0.015	GC	88								
Maize forage	8.2	AF	100	40	50			3.3	4.1		
Maize fodder	2.8	AS	100	25	15			0.7	0.42		
Maize, milled by-products	0.02	–	85								
Pea vines (green)	0.10	AL	100								
Sorghum	0.04	GC	86			80	90			0.037	0.042
Sorghum stover (fodder)	0.29	AS	100								
Sugar beet, tops	3.0	AV	100								
Wheat	0.015	GC	89								
Wheat, milled by-products	0.03	–	88			20	10			0.007	0.003
Wheat, straw	0.54	AS	100								
Total				100	100	100	100	4.5	5.0	0.044	0.045

Acceptable feeding studies were provided for chickens, cows, and swine. Hens were fed chlropyrifos in their daily rations at a rate of 0, 0.3, 3, or 10 ppm for 30 days. No residues (< 0.01 mg/kg) of chlorpyrifos were found in muscle, liver, or kidney at any concentration. Chlorpyrifos was found in peritoneal fat at concentrations of < 0.01–0.01 mg/kg in hens at 3 ppm and at 0.02–0.05 mg/kg at 10 ppm. Over a 45-day feeding period of chlorpyrifos at 10 ppm in the feed, the concentration in eggs was < 0.01–0.01 mg/kg, reaching a plateau within 10 days. The calculated dietary burdens are 0.77 ppm on the basis of the MRL and 0.044 ppm on the basis of the STMR value. In hens at 2 ppm, residues were found at a concentration near the LOQ in fat only. The Meeting estimated the following maximum residue levels: poultry meat (fat), 0.01 mg/kg; eggs, 0.01* mg/kg; and offal, 0.01* mg/kg. The STMR values were estimated to be 0.001 mg/kg for meat (fat),0.001 mg/kg for eggs, and 0.00 mg/kg for offal. The HR values were estimated to be 0.01 mg/kg for each of eggs, meat (fat), and offal.

Heifers were given capsules containing chlorpyrifos at a concentration of 0, 3, 10, 30, or 100 ppm for 30 days. In animals at 10 ppm, residues were found in muscle (0.02 mg/kg) and liver (0.02 mg/kg). At 100 ppm, the concentration in muscle increased to 0.29 mg/kg, but that in liver remained constant. Kidney was found to contain chlorpyrifos (0.02 mg/kg) only in animals at the highest dose (100 ppm). Fat showed concentrations of 0.01–0.03 mg/kg in animals at 3 ppm, which increased to 2.0–4.2 mg/kg at 100 ppm. At 30 ppm, which is comparable to the calculated dietary burden of 24 ppm based on MRLs, the concentrations were 0.02 mg/kg (< 0.01–0.02 mg/kg) in muscle, 0.99 mg/kg (0.18–0.99 mg/kg) in fat, and 0.01 mg/kg in each of liver and kidney. In animals at 10 ppm, which is

comparable to the 4.5 ppm dietary burden based on STMR values, the concentrations were < 0.01–0.02 mg/kg in meat and liver, < 0.01 mg/kg in liver, and 0.15 mg/kg (0.07–0.15 mg/kg) in fat. The Meeting estimated the maximum residue levels for cattle commodities to be: meat (fat), 1.0 mg/kg, liver, 0.01 mg/kg, and kidney, 0.01 mg/kg, and those for sheep commodities to be: meat (fat), 1.0 mg/kg; edible offal, 0.01 mg/kg. It estimated the STMR values for cattle commodities to be: meat, 0.02 mg/kg; liver, 0.01 mg/kg; and kidney, 0.01 mg/kg, and those for sheep commodities to be: meat, 0.02 mg/kg; edible offal, 0.01 mg/kg. The Meeting estimated the HR values for cattle commodities to be: meat, 0.02 mg/kg; kidney, 0.01 mg/kg; and liver, 0.01 mg/kg, and those for sheep commodities to be: meat, 1 mg/kg; edible offal, 0.01 mg/kg.

Cows were fed rations containing 0.3, 1, 3, 10, or 30 ppm of chorpyrifos for 14 consecutive days. Residues were found in whole milk at a maximum of 0.02 mg/kg only in cows fed 30 ppm. Residues were found in cream at maximum concentrations of 0.01, 0.04, and 0.15 mg/kg at 3, 10, and 30 ppm, respectively. The concentration of chlorpyrifos residue reached a plateau within 6 days. No detectable residues were found in cows fed 30 ppm after a 1-day withdrawal period. The dietary burden, based on MRLs, was estimated to be 22 ppm for dairy cattle. The Meeting estimated the maximum residue level in whole milk to be 0.02 mg/kg on the basis of the maximum residue level of 0.02 mg/kg at 30 ppm. The dietary burden based on STMR values was estimated to be 5.0 ppm. The Meeting estimated the STMR value for whole milk to be 0.005 mg/kg, on the basis of the concentration of < 0.01 mg/kg in milk of cows at 10 ppm.

Pigs were fed chorpyrifos in their diets at a concentration of 0, 1, 3, or 10 ppm for 30 days. The concentrations of residues found in pigs at 30 ppm were 0.03 mg/kg in muscle, 0.01 mg/kg in liver, and 0.18 mg/kg in omental, renal, and subcutaneous fat. In pigs at 3 and 1 ppm, residues were found only in fat (0.02 mg/kg), muscle, liver, and kidney, each containing < 0.01 mg/kg. The calculated dietary burdens are 0.77 and 0.045 ppm on the basis of MRLs and STMR values, respectively. At these levels, the estimated concentrations of chlorpyrifos in tissues are estimated to be < 0.01 mg/kg, except for 0.02 mg/kg in fat, on the basis of MRLs, and 0.002 mg/kg in fat and 0.00 mg/kg in other tissues on the basis of STMR values. The MLR for pig meat (fat) was estimated to be 0.02 mg/kg, the STMR value was estimated to be 0.001 mg/kg, and the HR value was estimated to be 0.01 mg/kg. The STMR value and MRL for offal were estimated to be 0.00 mg/kg and 0.01* mg/kg, respectively. The HR value for pig offal was estimated to be 0.01 mg/kg.

Dermal application of chlorpyrifos is no longer a veterinary use.

Further work or information

Desirable

Study of the stability of analytical samples of farm animal commodities in frozen storage

Dietary risk assessment

Chronic intake

STMR or STMR-P levels were estimated by the present Meeting for 61 commodities. When data on consumption were available, these values were used in the estimates of dietary intake.

The dietary intakes in the five GEMS/Food regional diets, on the basis of the new STMR values, represented 1–6% of the ADI (Annex 3). The Meeting concluded that the intake of residues of

chlorpyrifos resulting from uses that have been considered by the JMPR is unlikely to present a public health concern.

Short-term intake

The IESTI for chlorpyrifos was calculated for the commodities for which MRLs, STMR values, and HR values were established and for which data on consumption (of large portions and unit weight) were available. The results are shown in Annex 4.

The acute RfD for chlorpyrifos is 0.1 mg/kg bw. The calculated short-term intakes of those commodities for which calculations were possible were less than 100% of the acute RfDs for children and for the general population. The Meeting concluded that the intake of residues of chlorpyrifos resulting from uses that have been considered by the JMPR is unlikely to present a public health concern for consumers.

4.7 DDT (*p,p'*-Dichlorodiphenyltrichloroethane) (021)

Toxicological evaluation

Several Joint Meetings between 1963 and 1984 evaluated DDT in order to establish an ADI. An ADI of 0–0.02 mg/kg bw was allocated in 1984 for any combination of DDT, DDD, and DDE on the basis of data for both humans and experimental animals. The 1994 JMPR converted the ADI to a PTDI. An extensive range of studies on the biochemistry and toxicology of DDT and related compounds, including hormone-modulating effects, *in vivo* and *in vitro* has been reported since the 1984 JMPR. The present Meeting considered numerous reviews of the toxicity of DDT that have been published recently, and summarized new data on the toxicologically relevant effects of DDT and its metabolites. Mixtures of the *para,para'* and *ortho,para'* isomers of DDT, DDE, and TDE are referred to as the 'DDT complex'. Most of the studies that were reviewed by the present Meeting were published in the open literature and were not performed according to GLP.

The hepatic effects in rats include increased liver weights, hypertrophy, hyperplasia, induction of microsomal enzymes, including cytochrome P450, cell necrosis, increased activity of serum liver enzymes, and mitogenic effects, which might be related to a regenerative liver response to DDT. The potencies of DDT, DDE, and DDD for induction of CYP2B are of the same order of magnitude. The effects on CYP2B and associated enzymes indicated that males have a lower threshold than females, which induced these enzymes to a greater extent.

Conflicting data were obtained with regard to some genotoxic end-points. In most studies, DDT did not induce genotoxic effects in rodent or human cell systems nor was it mutagenic to fungi or bacteria. *para,para'*-DDE weakly induced chromosomal aberrations in cultured rodent cells and mutation in mammalian cells and insects, but not in bacteria. The induction of structural chromosomal aberrations in mouse spleen cells was maximal 24 h after intraperitoneal administration of DDT.

The Meeting could not reach a conclusion about the carcinogenicity of DDT in monkeys, as a 130-month study at one dose in nonhuman primates showed a small number of tumours at various sites. A working group convened by IARC classified the DDT complex as a non-genotoxic carcinogen in rodents and a potent promoter of liver tumours. The 1984 JMPR estimated that the lowest relevant NOAEL for carcinogenicity in rats was 6.2 mg/kg bw per day and concluded that "there is no significant risk of DDT producing tumours in humans". The overall evaluation of the IARC group was that "DDT is possibly carcinogenic to humans" but that "there is inadequate evidence in humans for the carcinogenicity of DDT". Epidemiological studies on the association between exposure to DDT and cancer risk were reviewed for the 2000 JMPR. The association between exposure to DDT and/or

DDE and breast cancer in women that was suggested in some case–control studies was not confirmed in later prospective studies. The results of studies of pancreatic cancer, multiple myeloma, non-Hodgkin lymphoma, and uterine cancer did not support the hypothesis of an association with environmental exposure to the DDT complex e.g. in food. Under circumstances of heavy, prolonged occupational exposure to technical-grade DDT, an increased risk for pancreatic cancer could not be excluded.

The 1984 JMPR concluded that "there is no firm evidence that DDT has any reproductive or teratogenic effects". The effects of DDT on reproduction and development in humans and experimental animal have been reviewed. After treatment of rabbits with 3 mg/kg bw for 12 weeks, increased serum concentrations of DDT were found, but no adverse effects on reproductive outcome were observed. The relevance for human reproduction of slight changes in the ovulation rate, the relative proportion of uteroglobin, and progesterone concentrations in rabbits is not clear. After perinatal exposure to *para,para´*-DDE, there was some evidence of impaired sexual development in male pups, including an increased frequency of thoracic nipple retention and a reduction in the male anogenital distance, with a NOAEL of 10 mg/kg bw per day. The Agency of Toxic Substances and Disease Registry concluded that the DDT complex could impair reproduction and/or development in mice, rats, rabbits, dogs, and avian species at doses 5 mg/kg bw per day. The lowest relevant NOAEL for developmental effects was reported to be 1 mg/kg bw per day in rats.

Data of limited usefulness for human risk assessment indicated changes in spontaneous behaviour and brain muscarinic receptors in mice receiving DDT by a single oral administration of a dose of 0.5 mg/kg bw on postnatal day 10. Similar effects were not observed when this dose was administered on other postnatal days. Three multigeneration studies in rats and mice showed no reproductive effects at doses of 1–6.5 mg/kg bw per day.

Quantitative measurements of the transfer of DDE from pregnant or lactating rats or rabbits to their fetuses or suckling neonates showed that the concentrations in rabbit fetuses were much higher than those in blastocysts and that, in rats, lactation is a quantitatively far more important route than transplacental. The persistent DDT metabolite in animals, 3-methylsulfonyl-DDE, is a potent transplacental and transmammary adrenal toxicant in mice. Treatment of mice with a single dose of 3 mg/kg resulted in mitochondrial destruction in the adrenal zona fasciculata.

Few data were available on reproductive effects in humans, and the few that were provided showed no correlation between exposure to DDT and stillbirth, miscarriage, or premature rupture of fetal membranes. In a study of 859 children in the USA who were tested at the age of 3, 4, or 5 years, neither transplacental nor lactational exposure to DDT affected psychomotor or mental behavioural patterns or measures of school performance, even when the PTDI was exceeded.

Activation of estrogen receptors and inhibition of androgen receptors may be mechanisms of the action of DDT-related compounds which lead to the observed perturbations of reproductive function. The *para,para'*-DDE metabolite acts as an antiandrogen. DDE binds to the androgen receptor *in vitro* and inhibits 5-dihydrotestosterone-induced transcriptional activation with a potency similar to that of the antiandrogenic drug hydroxyflutamide. The results of competitive binding assays showed that *ortho,para'*-DDT, *ortho,para'*-DDD, *ortho,para'*-DDE, and *para,para'*-DDT bind to the human estrogen receptor but with an approximately 1000-fold weaker affinity than that of estradiol.

Numerous studies have been conducted on the effect of DDT on the immune system of laboratory animals. Because no validated study protocols were used in different species, at different doses, application periods, and routes of exposure, and with evaluation of different parameters, a reliable NOAEL could not be stimated for effects on the immune system.

Pesticide applicators are exposed primarily to *para,para'*-DDT, whereas it is the *para,para'*-DDE metabolite to which the general population is exposed in the diet or drinking-water. Summaries of data on exposure and DDT concentrations in human tissues, milk, and blood have shown that the mean concentrations in populations have declined in much of the world, and the declines seen in various countries correspond to restrictions on DDT use. The available data on humans do not show causal relationships for carcinogenicity in any organ system or significant adverse health effects after repeated exposure to concentrations up to 0.25 mg/kg bw per day.

The newer studies and reviews provided the basis for a change by the present Meeting of the PTDI established in 1984. The Meeting derived a PDTI of 0.01 mg/kg bw on the basis of the NOAEL of 1 mg/kg bw per day for developmental toxicity in rats and a safety factor of 100.

DDT is no longer used in agricultural practice but may be present in food commodities as a contaminant because of its persistence in the environment. As peaks of acute dietary intake above the PTDI are not likely to occur, an acute RfD was not allocated.

A toxicological monograph addendum was prepared, summarizing the data that have become available since the previous evaluation.

Levels that cause no adverse toxic effects

Rat: 125 ppm, equivalent to 6.25 mg/kg bw per day (study of carcinogenicity; JMPR 1984)
1 mg/kg bw per day (developmental toxicity; review by the Agency of Toxic Substances and Disease Registry in 1994)

Monkey: 10 mg/kg bw per day (7-year study in the diet; JMPR 1984)

Humans: 0.25 mg/kg bw per day (overall NOAEL for humans; JMPR 1984)

Estimate of provisional tolerable daily intake for humans

0.01 mg/kg bw

Estimate of acute reference dose

Unnecessary

Residue and analytical aspects

DDT was first evaluated in 1966 and has been reviewed several times since. The existing Codex MRL for meat, 5 mg/kg (fat), was converted to a temporary limit in 1993. The Joint Meeting in 1993 and 1994 proposed extraneous residue limits (ERLs) for carrots, eggs, meat, and milk and confirmed the previous temporary ERL proposed for cereal grains. For meat, the 1993 JMPR proposed an ERL of 1 mg/kg. On the basis of new data on residues received from the Government of New Zealand, the 1996 JMPR concluded that the ERL of 1 mg/kg for DDT in meat (fat) recommended by the 1993 JMPR should be increased to 5 mg/kg.

At its thirty-first session, the CCPR (ALINORM 99/24A par. 115-121) discussed the temporary ERL in meat of 5 mg/kg. On the basis of a 0.5% rate of violation of this value, 3 mg/kg appeared to be an appropriate value from the 1996 evaluation. This value does not, however, conform to the geometric progression approach used by the Meeting for estimating MRLs and ERLs. The CCPR requested JMPR to reconsider its proposal on statistical validity and non-conformity to the geometric progression, on the basis of the 1996 JMPR evaluation.

Residues in animal commodities

The CCPR at its thirtieth session (ALINORM 99/24 par.102) requested the Meeting to evaluate data derived from monitoring of chicken meat in its consideration of an ERL for that commodity. These data were provided to the Meeting from Germany, Israel, Poland, Thailand, the United Kingdom, and the USA. The Meeting also received national residue limits from the Netherlands and Poland and methods for residue analysis and monitoring of fruits and vegetables from the Netherlands. The Meeting was informed by the Governments of Germany and the Netherlands that no uses for DDT are authorized in those countries.

The results of monitoring of DDT residues were summarized in tables in which only the number of results within certain classes was given. This method of reporting has the advantages of concentrating data and allowing rapid visual interpretation. The disadvantages are that such tables are difficult to compare (the definition of classes might differ) and parameters such as "the critical level at which only 0.2% of the results is above the critical level" are difficult to determine. A statistical solution to this problem was used which is based on the assumption that each set of data can be described by a log-normal distribution. The two parameters of this distribution were estimated by maximizing the likelihood of observing the numbers reported in the classes. Since the amount of information in the data sets was rather limited, combinations of sets were made. The same standard deviation was used for all data sets except those of Thailand, and, in the case of mammalian meat, New Zealand.

A total of 103 data sets on *mammalian meat* was abstracted from the 1996 JMPR evaluation of DDT. The data sets were derived from Australia, Germany, New Zealand, Norway, Thailand, the United Kingdom, and the USA. As the data from New Zealand showed higher concentrations of residues than those from other countries, the calculations were also performed exclusively for the New Zealand data. Nevertheless, one set of data on lamb meat from a region of New Zealand with a known history of exposure to DDT was not incorporated in either calculation (see 1996 JMPR DDT evaluation, Table 4).

Since the number of samples analysed in each data set varied widely, the calculations were repeated after introduction of a weighting factor to correct for the size of the data set, giving more weight to the large ones. This procedure does justice to each sample analysed, but it has a greater effect on the outcome of the calculations for those countries that provided the larger data sets.

The estimated percentage of samples in which the concentration of residues exceeds a certain concentration is called the "violation rate". Shown below for violation rates of 0.1. 0.2, and 0.5% are the average corresponding concentrations based on all the data sets, both giving each data set the same weight and weighing each data set according to the number of samples analysed. The second table gives the same information only from the data sets provided by New Zealand. In the parameter estimations, data sets are not included in the ranges where they have no discriminating power. For example, as the New Zealand data sets contain 310 samples they cannot discriminate below a violation rate of 0.3%. Once the parameters are established, they can be used to extrapolate to concentrations below 0.3%.

Weighted average of the estimated concentration of DDT (sum of *o,p'*-DDT, *p,p'*-DDT, *p,p'*-DDE, and *p,p'*-TDE (*p,p'*-DDD), expressed as DDT) in mammalian meat (fat) samples at various violation rates. Calculations based on data sets from Australia, Germany, New Zealand, Norway, Thailand, the United Kingdom, and the USA

Concentration (mg/kg)	Violation rate (%)		
	0.1	0.2	0.5
Average	2.1	1.4	0.8
Weighted average	1.9	1.2	0.6

Weighted average of the estimated concentration of DDT (sum of *o,p'*-DDT, *p,p'*-DDT, *p,p'*-DDE, and *p,p'*-TDE (*p,p'*-DDD), expressed as DDT) in mammalian meat (fat) samples at various violation rates. Calculations based on data sets from New Zealand only

Concentration (mg/kg)	Violation rate (%)		
	0.1	0.2	0.5
Average	3.9	2.7	1.7
Weighted average	4.8	3.4	2.1

Data sets on *poultry meat* were provided to the Meeting by Germany, Israel, Poland, Thailand (monitoring data), the United Kingdom, and the USA, and additional data sets from Australia, Germany, Norway, Thailand, the United Kingdom, and the USA were collected from the 1996 JMPR evaluation on DDT, yielding a total of 68 data sets. The same calculations were performed as for mammalian meat, and the results are given below, where for violation rates of 0.1. 0.2, and 0.5% the average corresponding concentration is shown when each item has the same weight and when each item is weighted by the number of samples analysed in the set.

Weighted average of the estimated concentration of DDT (sum of *o,p'*-DDT, *p,p'*-DDT, *p,p'*-DDE, and *p,p'*-TDE (*p,p'*-DDD), expressed as DDT) in poultry meat (fat) samples at various violation rates. Calculations based on data sets from Australia, Germany, Israel, Norway, Poland, Thailand, the United Kingdom, and the USA

Concentration (mg/kg)	Violation rate (%)		
	0.1	0.2	0.5
Average	0.19	0.15	0.10
Weighed average	0.29	0.24	0.19

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Recommendations

The Meeting concluded that selection of an acceptable violation rate and the weight to be given to information provided by individual countries are risk management issues, not scientific ones. CCPR should decide which violation rate is acceptable and whether each contributing country or each analysed sample should be given the same weight. When this is decided, suitable ERLs for mammalian and chicken meat can be derivedducted from the tables, in which the estimated concentrations of total DDT are given for violation rates of 0.1, 0.2, and 0.5%.

Dietary risk assessment

Chronic intake

ERLs for DDT exist for carrot, cereal grains, eggs, and milk. The present Meeting estimated the concentrations of DDT for violation rates of 0.1, 0.2, and 0.5% in meat from mammals other than marine mammals and from poultry. For dietary intake calculations, the 'worst case' was assumed to be the highest values in the tables. Thus, 5 mg/kg for mammalian meat and 0.3 mg/kg for poultry meat would be used.

The IEDI values from the five GEMS/Food regional diets, based on ERLs, were 10–30% of the PTDI of 0.01 mg/kg bw. The Meeting concluded that the long-term intake of residues of DDT resulting from its presence in carrots, cereal grains, eggs, milk, and meat (both mammalian and poultry) has been considered by the JMPR and is unlikely to present a public health concern.

Short-term intake

The Meeting concluded that an acute RfD for DDT is unnecessary. This conclusion was based on a determination that the residues of this contaminant are unlikely to present an acute risk to consumers.

4.8 Deltamethrin (135)

Toxicological evaluation

Deltamethrin [(*S*)-α-cyano-3-phenoxybenzyl(1*R*,3*R*)-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate] was first reviewed by the 1980 JMPR, when it was determined that there was insufficient information to establish an ADI. Additional data were received and reviewed by the 1981 JMPR (from a 2-year feeding study in dogs, a 2-year study of carcinogenicity in mice, studies of teratogenicity in mice and rats, additional information on mutagenicity, and human data), but again no ADI was established. The 1982 JMPR received the results of studies that helped to clarify previous concerns, particularly with regard to embryotoxicity, and an ADI of 0–0.01 mg/kg bw was established. Deltamethrin was reviewed by the present Meeting within the periodic review programme of the CCPR.

Deltamethrin is a synthetic pyrethroid insecticide. Its insecticidal action is due, like all the synthetic pyrethroids, to interaction with ion channels on the axons of the target species.

The metabolism of [^{14}C]deltamethrin was studied in rats, lactating cattle, and laying hens. The compound was rapidly absorbed, distributed, and excreted in rats and laying hens after oral administration, but it appeared to be poorly absorbed from the intestines of cattle. In rats, deltamethrin was readily metabolized and excreted, with a half-time in blood of about 6 h. In urine, only metabolites were detected, whereas in the faeces small amounts of parent compound were also detected.

The basic metabolic reactions are cleavage of the ester bond by oxidation and/or hydrolysis, followed by oxidation of the released acid and alcohol moieties. The acid moiety, 3-(2,2-dibromovinyl)-2,2-dimethylcyclo-propanecarboxylic acid, is transformed into conjugates, chiefly in the form of glucuronide, and excreted in urine. It can also be hydroxylated at one of the *gem*-methyl groups, which is in turn conjugated and excreted. The unstable alcohol moiety is transformed via the aldehyde to 3-phenoxybenzoic acid, which undergoes further oxidation by hydroxylation on the aromatic rings. It is then extensively excreted in urine, mainly as the 4′-hydroxy sulfate conjugate. Rapid ester cleavage is the major detoxification step in the metabolism of deltamethrin, suggesting that the parent compound is the only residue of toxicological concern.

As a type II pyrethroid, deltamethrin induces the ‘CS syndrome’, characterized by choreoathetosis (coarse tremors progressing to sinuous writhing), sedation, salivation, dyspnoea, and/or clonic seizures, sometimes with body tremors and prostration. These toxic signs, observed in various animal species given deltamethrin, are characteristic of a strong excitatory action on the nervous system resulting from a specific interaction between deltamethrin and the sodium channels of the nerve membranes. Series of nerve impulses are induced as a result of a change in the permeability of the membranes to sodium (repetitive effect). The nerve endings of sensory organs are particularly sensitive, although other parts of the nervous system are also affected.

The toxicity of deltamethrin is influenced by the vehicle. Thus, the oral LD_{50} value in rats is 30–140 mg/kg bw when the compound is administered in an oily vehicle, but > 5000 mg/kg bw when it is administered as an aqueous suspension. The dermal LD_{50} in rats was > 800 mg/kg bw when it was

applied in xylene, but this dose produced no signs of toxicity when applied in methylcellulose; the LD_{50} after administration in this vehicle was > 2940 mg/kg bw. The LC_{50} value in rats of deltamethrin aerosol was 790 mg/m^3. Deltamethrin is not irritating to the skin or eyes, and no sensitizing potential has been demonstrated. WHO has classified deltamethrin as 'moderately hazardous'.

Studies of repeated administration by inhalation, orally, and dermally to mice, rats, rabbits, guinea-pigs, and dogs showed that deltamethrin induces mainly agitation, hypersensitivity, impaired locomotor activity, and reduced body-weight gain. The NOAEC was 9.6 mg/m^3 (equivalent to approximately 2.6 mg/kg bw) in a 3-week study in rats in which the LOAEC was 56 mg/m^3. In dogs, the NOAEL was 1 mg/kg bw per day in a 1-year study of administration in capsules, on the basis of altered behaviour and liquid faeces at 10 mg/kg bw per day. In a 2-year dietary study, the NOAEL was 1 mg/kg bw per day, the highest dose tested. In rabbits treated cutaneously for 21 days with deltamethrin in an aqueous vehicle (PEG 400), the NOAEL was 1000 mg/kg bw per day, the highest dose tested.

In three long-term studies in two strains of mice (CD-1 and C57BL/6) in different laboratories, deltamethrin was not carcinogenic. The NOAEL for long-term toxicity was 100 ppm, equal to 16 mg/kg bw per day, on the basis of skin ulceration secondary to scratching and irritation due to the pharmacological effects of deltamethrin at 1000 ppm, equal to 160 mg/kg bw per day. In rats, the weight of evidence from three studies conducted in different laboratories and in different strains (CD, BDV1, and Crl:CD(SD)) indicated that deltamethrin was not carcinogenic. An increased frequency of thyroid tumours seen in one of these studies was not dose-related, and no increase in incidence was seen in the other two studies. The NOAEL for long-term toxicity in rats was 25 ppm, equal to 1.1 mg/kg bw per day, on the basis of minor hepatoxicity at 125 ppm, equal to 5.4 mg/kg bw per day.

Deltamethrin was tested for genotoxicity in an adequate range of assays, both *in vitro* and *in vivo*, and gave no evidence of genotoxicity.

Because of the absence of a carcinogenic effect in long-term experiments in rats and mice, the Meeting concluded that exposure to deltamethrin is unlikely to be a carcinogenic hazard to humans.

In a multigeneration study of reproductive toxicity in rats, the NOAEL for systemic toxicity was 80 ppm, equal to 4.2 mg/kg bw per day, on the basis of clinical signs in females during gestation and lactation, reduced food consumption and body-weight gain, and an increased mortality rate at 320 ppm, equal to 18 mg/kg bw per day; the NOAEL for toxicity in the offspring was also 80 ppm, equal to 11 mg/kg bw per day, on the basis of reduced body-weight gain, clinical signs, and an increased mortality rate before and after weaning up to 18 days. There were no adverse effects on mating performance or fertility, and the NOAEL for reproductive toxicity was 320 ppm, equal to 18 mg/kg bw per day, the highest dose tested.

In a study of developmental toxicity in mice, the NOAEL for maternal toxicity was 3 mg/kg bw per day on the basis of reduced body-weight gain and convulsions at 6 mg/kg bw per day. There were no malformations or developmental variations, and the NOAEL for developmental toxicity was 12 mg/kg bw per day, the highest dose tested. In a study of developmental toxicity in rats, the NOAEL for maternal toxicity was 3.3 mg/kg bw perday on the basis of clinical signs, reduced body-weight gain, and an increased mortality rate. The NOAEL for developmental toxicity was 11 mg/kg bw per day in the absence of malformations and developmental variations in fetuses at the highest dose. In a study of peri- and postnatal toxicity in rats, the NOAEL for perinatal development was 2.5 mg/kg bw per day, on the basis of reduced pup weight gain at 5.0 mg/kg bw per day. In a study of developmental toxicity in rabbits, the NOAEL for maternal toxicity was 25 mg/kg bw per day on the basis of the death of one of 16 females at 100 mg/kg bw per day, although there were no signs of maternal toxicity

at any dose. The NOAEL for developmental toxicity was 25 mg/kg bw per day, on the basis of retardation of ossification at 100 mg/kg bw per day.

The results of acute and 90-day studies of neurotoxicity in rats and of acute delayed neurotoxicity in hens showed that deltamethrin does not induce neuropathological changes. The NOAEL for neurotoxicity in a study in rats given a single dose by gavage was 5 mg/kg bw on the basis of effects in a battery of tests for function and locomotor activity at 15 mg/kg bw per day. The NOAEL for systemic toxicity and neurotoxicity in a 90-day study in rats was 200 ppm, equal to 14 mg/kg bw per day, on the basis of effects on function in a battery of tests at 800 ppm, equal to 54 mg/kg bw per day, the highest dose tested.

Paresthaesia has been observed among exposed workers, but the symptoms were reversible upon cessation of exposure.

The Meeting concluded that the existing database was adequate to characterize the potential hazard of deltamethrin to fetuses, infants, and children. Although deltamethrin is known to be neurotoxic to adults, the Meeting did not recommend that a study of developmental neurotoxicity be conducted since there was no evidence that offspring exposed pre- or postnatally are more sensitive than adults in the same experiment.

An ADI of 0–0.01 mg/kg bw was established for deltamethrin on the basis of the NOAEL of 1 mg/kg bw per day in a 1-year study in dogs treated by capsule, a 2-year study in dogs treated in the diet, and two 2-year studies in rats treated in the diet, with a safety factor of 100.

The Meeting established an acute RfD of 0.05 mg/kg bw on the basis of the NOAEL of 5 mg/kg bw in the study of acute neurotoxicity in rats and applying a safety factor of 100.

A toxicological monograph was prepared.

Levels relevant for risk assessment

Species	Study	Effect	NOAEL	LOAEL
Mouse	97-week study of toxicity and carcinogenicity[a]	Toxicity	100 ppm, equal to 16 mg/kg bw per day	1000 ppm, equal to 160 mg/kg bw per day
		Carcinogenicity	2000 ppm, equal to 320 mg/kg bw per day[b]	–
	Reproductive toxicity[c]	Maternal toxicity	3 mg/kg bw per day	6 mg/kg bw per day
	Developmental toxicity		12 mg/kg bw per day[b]	–
Rat	104-week study of toxicity and carcinogenicity[a]	Toxicity	20 ppm, equivalent to 1 mg/kg bw per day	50 ppm, equivalent to 2.5 mg/kg bw per day
		Carcinogenicity	800 ppm, equal to 36 mg/kg bw per day[b]	–
	Two-generation reproductive toxicity[a]	Dam and pup toxicity	80 ppm, equal to 4.2 mg/kg bw per day	320 ppm, equal to 18 mg/kg bw per day
		Reproductive toxicity	320 ppm, equal to 18 mg/kg bw per day[b]	–
	Developmental toxicity[c]	Dam and pup toxicity	2.5 mg/kg bw per day	5 mg/kg bw per day
	Acute neurotoxicity[c]	Neurotoxicity	5 mg/kg bw	15 mg/kg bw per day
	13-week study of neurotoxicity[a]	Neurotoxicity	200 ppm, equal to 14 mg/kg bw per day	800 ppm, equal to 54 mg/kg bw per day
Rabbit	Developmental toxicity[c]	Maternal, embryo-, and fetotoxicity	25 mg/kg bw per day	100 mg/kg bw per day

Dog	1-year[d] and 2-year studies of toxicity[a]	Toxicity	1 mg/kg bw per day	10 mg/kg bw per day

[a]Dietary administration
[b]Highest dose tested
[c]Gavage
[d]Capsule

Estimate of acceptable daily intake for humans

0–0.01 mg/kg bw

Estimate of acute reference dose

0.05 mg/kg bw

Studies that would provide information useful to the continued evaluation of the compound

- Further studies in humans

Summary of critical end-points

Absorption, distribution, excretion and metabolism in mammals	
Rate and extent of absorption:	Rapid
Distribution:	Mainly to liver, ovaries, kidneys, blood, and fat
Potential for accumulation:	Low
Rate and extent of excretion:	Rapid, 87–95% in rats
Metabolism in animals	Extensive; cleavage of ester by oxidation or hydrolysis, hydroxylation, then oxidation and conjugation
Toxicologically significant compounds (animals, plants and environment)	Parent compound
Acute toxicity	
Rat, LD_{50}, oral	30–130 mg/kg bw in oily vehicle; > 5000 mg/kg bw in aqueous vehicle
Rat, LD_{50}, dermal	> 800 in xylene solvent
Rat, LC_{50}, inhalation	790 mg/m^3
Dermal irritation	Not irritating to rabbit skin
Ocular irritation	Not irritating to rabbit eyes
Dermal sensitization	No sensitizing potential in guinea-pigs
Short-term toxicity	
Target/critical effect	Nervous system
Lowest relevant oral NOAEL	1 mg/kg bw per day in dogs
Lowest relevant dermal NOAEL	1000 mg/kg bw per day in rabbits
Lowest relevant inhalation NOAEC	9.6 mg/m^3 in rats
Genotoxicity	Not genotoxic
Long-term toxicity and carcinogenicity	
Target/critical effect	No consistently identified target in rats or mice
Lowest relevant NOAEL	Mice, 16 mg/kg bw; rats, 1 mg/kg bw
Carcinogenicity	Not carcinogenic to mice and rats
Reproductive toxicity	
Reproduction target/critical effect	None identified in rats

Lowest relevant reproductive NOAEL	18 mg/kg bw per day in rats, highest dose tested
Developmental target/critical effect	Rats and mice, none identified; rabbits, delayed ossification
Lowest relevant developmental NOAEL	Rats, 11 mg/kg bw per day; mice, 12 mg/kg bw per day; rabbits, 25 mg/kg bw per day
Neurotoxicity/Delayed neurotoxicity	NOAEL, 5 mg/kg bw per day in a single-dose study in rats NOAEL, 14 mg/kg bw per day in a 90-day study in rats; no delayed effect NOAEL > 5000 mg/kg bw per day in hens
Other toxicological studies	None
Medical data	Paresthaesia; irritation to skin and upper respiratory tract (perhaps due to solvents)

Summary	***Value***	***Study***	***Safety factor***
ADI	0–0.01 mg/kg bw	Two 2-year dietary studies in rats; 1-year and 2-year studies in dogs given capsules	100
Acute RfD	0.05 mg/kg bw	Study of acute neurotoxicity in rats	100

Dietary risk assessment

The estimated theoretical maximum daily intakes from the five GEMS/Food regional diets, on the basis of existing MRLs, represented 40–70% of the ADI (Annex 3). The Meeting concluded that the intake of residues of deltamethrin resulting from uses that have been considered by the JMPR is unlikely to present a public health concern.

4.9 Dinocap

Toxicological evaluation

At its thirty-second session, the CCPR (ALINORM 01/24: paragraph 113) considered the 1998 JMPR evaluation of dinocap and noted that the acute RfD of 0.008 mg/kg bw was based on developmental effects resulting from prenatal exposure. Estimates of the acute dietary intake of children showed that this acute RfD was exceeded. The CCPR asked JMPR whether an alternative acute RfD would be appropriate for children. Dinocap disrupts oxidative phosphorylation, and the LD_{50} values in mice, the most sensitive species, were 50–300 mg/kg bw. This profile suggests that an acute RfD should be established for the general population.

The Meeting was unable to identify an appropriate study from which to derive a robust acute RfD. It concluded that a conservative value could be derived from studies of repeated doses and established an acute RfD of 0.03 mg/kg bw on the basis of the NOAEL of 15 ppm (equal to 2.7 mg/kg bw per day) in a long-term study of toxicity in mice. This acute RfD applies to the general population, with the exception of women of childbearing age.

The Meeting noted that the sponsor of dinocap may wish to perform a study designed specifically to generate data appropriate for setting an acute RfD (for sub-populations other than women of childbearing age). A draft guideline for such a study is proposed by JMPR as Annex 5 of this report.

Dietary risk assessment

Short-term intake

The present JMPR established an acute RfD of 0.008 mg/kg bw for women of childbearing age and an acute RfD of 0.03 mg/kg bw for the remainder of the general population. The IESTI for dinocap was calculated for the commodities for which maximum residue levels and STMR and HR values were estimated by the Meeting in 1994 and 1999 and for which data on consumption (of large portions and unit weight) were available (see Section 3). The results are shown in Annex 4. The IESTI varied from 0 to 40% of the acute RfD for the general population, excluding women of childbearing age, and from 1 to 150 % for women of childbearing age. The Meeting concluded that the intake of residues of dinocap resulting from uses that have been considered by the JMPR, except on grapes, is unlikely to present a public health concern. The information provided to the Meeting precluded an estimate that the acute dietary intake of dinocap from the consumption of grapes would be below the acute RfD.

4.10 Dodine (084)

Toxicological evaluation

Dodine was first evaluated by the JMPR in 1974, when a temporary ADI of 0–0.01 mg/kg bw was established on the basis of a NOAEL of 50 ppm (equivalent to1.25 mg/kg bw per day) for effects on the thyroid in a 1-year study in dogs. The Meeting at that time required studies of the metabolism of dodine in animals and plants and considered that it would be desirable to have the results of studies of teratogenicity studies in appropriate animal species. Additional data on metabolism in rats were evaluated by the Joint Meeting in 1976. The ADI was maintained at 0–0.01 mg/kg bw. A significant number of studies have since been conducted. Dodine was reviewed by the present Meeting within the periodic review programme of the CCPR.

The absorption, distribution, and excretion of radiolabelled dodine were investigated in rats given low (40 mg/kg bw) single and repeated doses and a high dose (400 mg/kg bw). Less than 50% of the administered dose was absorbed. By 120 h after dosing, the amount of the administered dose excreted in urine (41–45%) and faeces (48–60%) was similar in all groups. Most of the radiolabel in urine and faeces was excreted within the first 48 h by the group at the low dose and by 96 h by those at the high dose. Little radiolabel was recovered in the tissues at 120 h, and 3.4% of the administered dose was retained. In general, the recovery of radiolabel was similar in males and females.

Dodine was extensively metabolized, and no unmetabolized parent compound was detected in urine. The metabolic profile was similar in the two sexes and at all doses. Four metabolites were identified in urine. The major one was hydroxydodecylguanidine, an ω-oxidation product, which accounted for 11–24% of the administered dose. The minor metabolite was identified as urea, whereas the other two were not clearly identified. In faecal samples, the parent compound was identified as the major component (39–55%).

Dodine was slightly toxic in mice and rats given single oral doses. In male mice, the LD_{50} was 1700 mg/kg bw. In rats, the LD_{50} values were 750–1900 and 660–1100 mg/kg bw in males and females, respectively. The compound was moderately toxic when given by inhalation; the LC_{50} was 0.47 and 0.44 mg/l for males and females, respectively. Dodine was not toxic after single dermal administration; the LD_{50} value in rabbits and rats was > 2000 and > 5000 mg/kg bw, respectively. It was a severe ocular and dermal irritant, but it is not a dermal sensitizer. WHO has classified dodine as slightly hazardous.

In short- and long-term studies of toxicity in rodents, rabbits, and dogs, the most consistently observed effects were decreased body weight and body-weight gain, which were frequently accompanied by decreased food consumption. The NOAELs for these parameters were similar in the short- and long-term studies and between species. Other toxic effects were reported only rarely in these studies.

In an 8-week study of toxicity mice at a dietary concentration of 0, 100, 250, or 625 ppm, in which the 100-ppm dose was increased to 1250 ppm after 3 weeks, one death possibly related to treatment, decreased body-weight gain, and cytoplasmic eosinophilia in hepatocytes were observed at 1250 ppm, equal to 230 mg/kg bw per day, the highest dose tested. The NOAEL was 625 ppm, equal to 110 mg/kg bw per day. In a 90-day study of toxicity in mice at a dietary concentration of 0, 150, 300, 600, 1250, or 2500 ppm, four of five females at 2500 ppm died during the first 2 weeks of treatment. Decreased body weight, body-weight gain, and food consumption were observed at 1250 ppm, equal to 180 mg/kg bw per day. The NOAEL was 600 ppm, equal to 94 mg/kg bw per day. In a 28-day study of toxicity in rats at a dietary concentration of 0, 500, 750, or 1000 ppm, decreased body weight, body-weight gain, and food consumption were observed at 750 ppm, equal to 71 mg/kg bw per day. The NOAEL was 500 ppm, equal to 47 mg/kg bw per day. In another 28-day study in rats at a dietary concentration of 0, 200, or 800 ppm, decreased body weight, body-weight gain, and food consumption were reported at 800 ppm, equal to 68 mg/kg bw per day. The NOAEL was 200 ppm, equal to 18 mg/kg bw per day. In a 4-week study in rats given a dose of 0, 75, 100, or 200 mg/kg bw per day by oral gavage, an increased mortality rate, clinical signs of toxicity, decreased body weight, body-weight gain, and food consumption, and histological alterations in the gastrointestinal tract (oedema, mixed-cell infiltration, and hyperplasia of the squamous mucosa of the stomach) were reported at 75 mg/kg bw per day. A NOAEL was not identified. In a 90-day study of toxicity in rats at a dietary concentration of 0, 50, 200, or 800 ppm, decreased body weight and body-weight gain were observed at 800 ppm, equal to 56 mg/kg bw per day. The NOAEL was 200 ppm, equal to 14 mg/kg bw per day. In a 5-week range-finding study, dogs that received dodine in gelatin capsules at increasing doses of 1.2–60 mg/kg bw per day showed clinical signs of toxicity (salivation, vomiting, liquid faeces), decreased body weight and food consumption, and abnormal gross necroscopic changes in the gastrointestinal tract (undigested food in the stomach and discolouration of the gastric mucosa of one dog) at 25 mg/kg bw per day. No consistent adverse effects were observed after treatment with dodine at doses up to 12 mg/kg bw per day for 1 week, although complete evaluation of this dose and duration was precluded by the increase of the dose to 50 mg/kg bw per day for the next 5 weeks. In a 1-year study of toxicity in dogs given capsules containing a dose of 0, 2, 10, or 20 mg/kg bw per day, decreased food intake by two animals at 20 mg/kg bw per day, which required supplemental feedings for the entire study, was the only adverse effect observed. In this study, salivation and emesis before and after dosing were reported in both treated and control animals, the incidence being higher with the two higher doses of dodine. These findings were considered to be toxicologically insignificant because there was no evidence of alterations in the gastrointestinal tract at necropsy, either macroscopically or microscopically. The NOAEL was 10 mg/kg bw per day.

In a study of mechanism of action, rats given up to 800 ppm of dodine in the diet for 7 or 28 days and then a charcoal suspension showed no evidence of altered gastrointestinal motility. Delayed gastric emptying, as measured by barium contrast radiography, was observed in one dog at 50 mg/kg bw per day in a 5-week range-finding study.

Studies of dermal toxicity in rats of 21 and 28 days' duration showed that dodine is severely irritating at a dose as low as 12 mg/kg bw per day. There was some evidence that dermal application at a dose as low as 50 mg/kg bw per day caused systemic toxicity (decreased body weight and body-weight gain), but the severe dermal irritation may have contributed to these findings.

In a 78-week study of carcinogenicity in mice at a dietary concentration of 0, 200, 750, or 1500 ppm, the only evidence of toxicity was decreased body-weight gain and food consumption at 750 ppm, equal to 110 mg/kg bw per day. The study was complicated by the inadvertent mis-dosing of females at 1500 ppm with approximately 9000 ppm of dodine during weeks 41–44. The NOAEL for toxicity was 200 ppm, equal to 29 mg/kg bw per day. A positive trend in the incidence of hepatocellular adenomas was observed in females and a statistically nonsignificant increase in the incidence of hepatocellular adenomas in females at 750 ppm. The high dose was considered adequate for testing the carcinogenic potential of dodine in mice. No pertinent data on historical controls were available. The Meeting concluded that the increased incidence of hepatocellular tumours was not relevant for human risk assessment because only benign tumours (adenomas) were observed, they occurred at a dose that exceeded the maximum tolerated dose, and they were reported in only one sex.

In a long-term study of toxicity and carcinogenicity in rats at a dietary concentration of 0, 200, 400, or 800 ppm, the only evidence of toxicity was decreased body weight, body-weight gain, and food consumption at 800 ppm, equal to 42 mg/kg bw per day. The NOAEL was 400 ppm, equal to 20 mg/kg bw per day. There was a statistically nonsignificant increase in the incidence of combined thyroid C-cell adenomas and carcinomas in males at 800 ppm, and the incidence in all treated males exceeded the mean and upper limit of the range for historical controls. However, the incidence in the concurrent control group also exceeded the mean of the historical controls. The high dose was considered marginally adequate for testing the carcinogenic potential of the chemical. The Meeting concluded that the increased incidence of thyroid C-cell adenomas and carcinomas was not relevant for human risk assessment because there was no statistically significant increase in the incidence of the tumours, they occurred in only one sex, and there was no clear dose–response relationship in the increased incidence of benign (adenomas) and malignant (carcinomas) tumours.

No evidence of genotoxicity was found *in vivo* or *in vitro*. The Meeting concluded that dodine is unlikely to be genotoxic.

In view of the lack of genotoxicity and the finding of tumours only at concentrations at which dodine was clearly toxic, the Meeting concluded that the compound is unlikely to pose a carcinogenic risk to humans.

There was no evidence that dodine is a developmental toxicant. The only possible evidence of reproductive toxicity was a decrease in the body weight of offspring in a two-generation study of reproductive toxicity in rats, in which maternal toxicity was observed at the same dose. In a two-generation study in rats at a dietary concentration of 0, 200, 400, or 800 ppm, decreased body weight, body-weight gain, and food consumption were observed in both the parental and F_1 generations at 800 ppm, equal to 53 mg/kg bw per day. There was no evidence of a treatment-related effect on reproductive parameters. The offspring of both F_1 and F_2 generations had decreased mean body weights at postnatal day 4 and through postnatal day 21 at a dose of 800 ppm. The NOAEL for toxicity to parents and offspring was 400 ppm (equal to 26 mg/kg bw per day). In a study of developmental toxicity in rats given a dose of 0, 10, 45, or 90 mg/kg bw per day by gavage, decreased body-weight gain was observed in maternal animals at 45 mg/kg bw per day. The NOAEL for maternal toxicity was 10 mg/kg bw per day. There was no evidence of developmental toxicity at 90 mg/kg bw per day. In a study of developmental toxicity in rabbits given a dose of 0, 10, 40, or 80 mg/kg bw per day by gavage, the evidence of maternal toxicity consisted of a possibly treatment-related death and decreased food consumption at 80 mg/kg bw per day. The NOAEL for maternal toxicity was 40 mg/kg bw per day. There was no evidence of developmental toxicity at 80 mg/kg bw per day.

The Meeting concluded that the existing database was adequate to characterize the potential hazard of dodine to fetuses, infants, and children. There was no evidence that offspring are more sensitive after pre- or postnatal exposure to dodine than are adults in the same experiment.

The Meeting established an ADI of 0–0.1 mg/kg bw for dodine on the basis of the NOAEL of 10 mg/kg bw per day in the 1-year study in dogs, supported by an identical NOAEL for maternal toxicity in the study of developmental toxicity in rats and applying a safety factor of 100. The 1-year study in dogs, which was used to establish the previous ADI (NOAEL, 50 ppm, equivalent to 1.25 mg/kg bw per day, on the basis of effects on the thyroid), was re-evaluated and found to be unacceptable by current standards.

The Meeting established an acute RfD of 0.2 mg/kg bw on the basis of the absence of toxicity after a single dose of 20 mg/kg bw per day in the 1-year study in dogs and applying a safety factor of 100.

A toxicological monograph was prepared, summarizing the data received since the previous evaluation and including relevant data from previous monographs and monograph addenda.

Levels relevant for risk assessment

Species	Study	Effect	NOAEL	LOAEL
Mouse	78-week study of toxicity and carcinogenicity[a]	Toxicity	200 ppm, equal to 29 mg/kg bw per day	750 ppm, equal to 110 mg/kg bw per day
		Carcinogenicity	1500 ppm, equal to 225 mg/kg bw per day[b]	–
Rat	104-week study of toxicity and carcinogenicity[a]	Toxicity	400 ppm, equal to 20 mg/kg bw per day	800 ppm, equal to 42 mg/kg bw per day
		Carcinogenicity	> 800 ppm, equal to 42 mg/kg bw per day[b]	–
	Two-generation study of reproductive toxicity[a]	Parental toxicity	400 ppm, equal to 26 mg/kg bw per day	800 ppm, equal to 53 mg/kg bw per day
		Reproductive toxicity	800 ppm, equal to 53 mg/kg bw per day[b]	–
		Pup toxicity	400 ppm, equal to 26 mg/kg bw per day	800 ppm, equal to 53 mg/kg bw per day
	Developmental toxicity[c]	Maternal toxicity	10 mg/kg bw per day	45 mg/kg bw per day
		Embryo- and fetotoxicity	90 mg/kg bw per day[b]	–
Rabbit	Developmental toxicity[c]	Maternal toxicity	40 mg/kg bw per day	80 mg/kg bw per day
		Embryo- and fetotoxicity	80 mg/kg bw per day[b]	–
Dog	1-year study of toxicity[d]	Toxicity	10 mg/kg bw per day	20 mg/kg bw per day

[a] Dietary administration
[b] Highest dose tested
[c] Gavage
[d] Capsule

Estimate of acceptable daily intake for humans

0–0.1 mg/kg bw

Estimate of acute reference dose

0.2 mg/kg bw

Studies that would provide information useful for further evaluation of the compound

- Observations in humans

Summary of critical end-points

Absorption, distribution, excretion and metabolism in mammals	
Rate and extent of oral absorption, rats:	Less than 50% absorbed; 41–45% excreted in urine; 48–60% excreted in faeces
Dermal absorption:	No studies
Distribution:	Largest amounts in gastrointestinal tract, muscle, and skin; no tissues contained > 1.1% of administered dose
Potential for accumulation:	Unknown
Rate and extent of excretion:	Most of single and repeated low dose (40 mg/kg bw) eliminated within 48 h; single high dose (400 mg/kg bw) eliminated within 120 h
Metabolism in animals:	Extensive; four metabolites in urine; major metabolite is hydroxydodecylguanidine
Toxicologically significant compounds (animals, plants and environment)	Parent; significance of metabolites unknown
Acute toxicity	
Rats, LD_{50}	Males: 750–1900 mg/kg bw; females: 660–1100 mg/kg bw
Rats, LD_{50}, dermal	> 5000 mg/kg bw
Rats, LC_{50}, inhalation	Males: 0.47 mg/l; females: 0.44 mg/l
Rabbits, dermal irritation	Severe dermal irritant
Rabbits, ocular irritation	Severe ocular irritant
Guinea-pigs, dermal sensitization	Not sensitizing
Short-term toxicity	
Target/critical effect	Decreased body weight and food consumption
Lowest relevant oral NOAEL, dogs	10 mg/kg bw per day
Lowest relevant dermal NOAEL, rats	25 mg/kg bw per day (decreased body weight evidence of possible systemic effects)
Lowest relevant inhalation NOAEL	Not determined
Genotoxicity	Unlikely to be genotoxic
Long-term toxicity and carcinogenicity	
Target/critical effect	Reduced body weight and food consumption
Lowest relevant NOAEL, rats	20 mg/kg bw per day (toxicity and carcinogenicity)
Carcinogenicity	Increased incidence of heptatocellular tumours in mice and thyroid C-cell tumours in rats judged to be irrelevant to human risk assessment
Reproductive toxicity	
Reproduction target/critical effect, rats	Decreased body weight of offspring
Lowest relevant reproductive NOAEL, rats	26 mg/kg bw per day
Developmental target/critical effect	None observed
Lowest relevant developmental NOAEL, rabbits	80 mg/kg bw per day
Neurotoxicity/Delayed neurotoxicity	No evidence of neurotoxicity
Other toxicological studies	None
Medical data	No relevant data

Summary	***Value***	***Study***	***Safety factor***
ADI	0–0.1 mg/kg bw	1-year study in dogs	100
Acute RfD	0.2 mg/kg bw	1-year study in dogs	100

Dietary risk assessment

The estimated theoretical maximum daily intakes from the five GEMS/Food regional diets, on the basis of existing MRLs, represented 0–7% of the ADI (Annex 3). The Meeting concluded that the intake of residues of dodine resulting from uses that have been considered by the JMPR is unlikely to present a public health concern.

4.11 Fenitrothion

Toxicological evaluation

Fenitrothion is a broad-spectrum organophosphorus pesticide. Its toxicity was first evaluated by the 1969 Joint Meeting, which established a temporary ADI of 0–0.001 mg/kg bw on the basis of a NOAEL of 0.25 mg/kg bw per day in a 3-month study in rats. In 1974, new data were reviewed, and the ADI was increased to 0–0.005 mg/kg bw on the basis of inhibition of plasma cholinesterase activity observed in a 92-week study in rats. This ADI was reaffirmed by the 1977 Joint Meeting. However, some of the pivotal studies used to establish the ADI were based on data generated by Industrial Bio-Test Laboratories and had not been validated. Replacement studies or independent validations were requested, but these were not available in time for the 1982 Joint Meeting. Consequently, a temporary, lower ADI of 0–0.001 mg/kg bw was established. At the 1984 Joint Meeting, the ADI was increased to 0–0.003 mg/kg bw but was still considered temporary owing to the absence of a suitable study of developmental toxicity. In 1986, an acceptable study of developmental toxicity in rats was reviewed, and an ADI of 0–0.003 mg/kg bw was established. The most recent review, in 1988, which reflected the new JMPR policy of using inhibition of brain cholinesterase activity (or erythrocyte acetylcholinesterase activity as a surrogate) instead of inhibition of plasma cholinesterase activity as the toxicologically relevant end-point for cholinesterase-inhibiting compounds, included data that had been reviewed previously and increased the ADI to 0–0.005 mg/kg bw on the basis of a NOAEL of 0.5 mg/kg bw per day in a 2-year study of toxicity in rats; this value was supported by a NOAEL of 0.65 mg/kg bw per day in a study of reproductive toxicity in rats. Fenitrothion was reviewed by the present Meeting within the periodic review programme of the CCPR.

After oral administration, fenitrothion is rapidly and extensively absorbed from the mammalian intestinal tract (about 90–100% of the dose) and eliminated, predominantly in the urine (up to about 93% of the dose) and faeces (6–15% of the dose), within 24 h. After dermal application, approximately 45% of an applied dose was absorbed within 24 h. Fenitrothion is rapidly metabolized by mixed-function oxidases to the highly reactive fenitrooxon by oxidative desulfuration. The oxon is then further metabolized by demethylation and hydrolysis to 3-methyl-4-nitrophenol and dimethylphosphate. A minor metabolic pathway involves further oxidation to 3-carboxyl-4-nitrophenol. After low oral doses, the urinary metabolites consisted mainly of conjugated phenolic compounds, such as the sulfate and glucuronide of 3-methyl-4-nitrophenol, whereas at higher doses demethylated compounds such as desmethyl fenitrothion and desmethyl fenitrooxon were excreted in increasing amounts. The tissue concentrations of residues of ^{14}C-fenitrothion were very low (generally < 1 ppm) within 48 h of dosing.

In volunteers, the time to maximal concentration in plasma after oral ingestion 12 h apart of two capsules containing fenitrothion at 0.09 or 0.18 mg/kg bw for 4 days, was 1 h, and the elimination half-time ranged from 2 to 3 h, irrespective of dose. The integrated area under the curve of concentration–time and the maximum concentration, however, increased with frequency of dosing. The maximal concentration in plasma 1 day after a single dose of 0.09 mg/kg bw was 0.54 ng/ml, whereas on day 4 it was 0.84 ng/mL. At the higher dose, the maximal concentration increased from 1.8 ng/ml on day 1 to 7.7 ng/ml on day 4. In a man who attempted to commit suicide by ingesting a fenitrothion formulation, the elimination half-time of fenitrothion was 4.5 h.

The lowest oral LD_{50} value was 240 mg/kg bw (range, 240–1700 mg/kg bw) in rats and 780 mg/kg bw (range, 780–1400 mg/kg bw) in mice. Male rats were generally more sensitive to the acute effects of fenitrothion than females, and the vehicle used had a marked effect on the observed toxicity. The signs of acute intoxication with fenitrothion were consistent with cholinesterase inhibition. The lowest acute dermal LD_{50} was 890 mg/kg bw (range, 890–5000 mg/kg bw) in rats. The lowest acute LC_{50} in rats after whole-body exposure to a fenitrothion aerosol was 2.2 mg/l. Technical-grade fenitrothion with a purity > 95% was not irritating to the eye or skin of rabbits and did not sensitize the skin of guinea-pigs (Buehler test). WHO has classified fenitrothion as moderately hazardous.

In short-term studies of toxicity lasting less than 12 months, the NOAEL for inhibition of erythrocyte acetylcholinesterase activity was 0.6 mg/kg bw per day in rats, < 3 mg/kg bw per day in rabbits, and 0.3 mg/kg bw per day in dogs. The NOAEL for inhibition of brain cholinesterase activity was 2.5 mg/kg bw per day in rats, 3 mg/kg bw per day in rabbits, and > 1.6 mg/kg bw per day in dogs. The signs of toxicity in rats and rabbits were generally limited to cholinergic signs and decreased body weights and/or food consumption. The NOAEL for these effects in short-term studies was 4.8 mg/kg bw per day in rats and > 10 mg/kg bw per day in rabbits. When fenitrothion was applied to the skin of rabbits for 21 days, the NOAEL for inhibition of cholinesterase activity in erythrocytes and brain was 3 mg/kg bw per day. No NOAEC was identified for inhibition of brain cholinesterase in rats exposed to an aerosol of fenitrothion for 90 days. The LOAEC was 0.2 $\mu g/m^3$ per day.

In long-term studies of toxicity, inhibition of cholinesterase activity was again the main toxicological finding in all species. In mice, erythrocyte and brain cholinesterase activities were inhibited at 13 mg/kg bw per day, with a NOAEL was 1.5 mg/kg bw per day. Reductions in body-weight gain and food consumption were reported only at the highest dietary concentration of 1000 ppm (equal to 130 mg/kg bw per day). Other treatment-related findings in mice were an elevated cholesterol concentration, with a NOAEL of 10 ppm (equal to 1.5 mg/kg bw per day), and a reduced glucose concentration, with a NOAEL of 100 ppm (equal to 13 mg/kg bw per day). Although no clinical signs were seen at doses up to 6.5 mg/kg bw per day in rats, the NOAEL was 0.5 mg/kg bw per day for inhibition of erythrocyte and brain cholinesterase activities; the NOAEL for a reduction in body-weight gain was 1.9 mg/kg bw per day. Treatment did not increase the incidence of neoplastic lesions in long-term studies in mice and rats.

On the basis of testing in an adequate range of studies *in vitro* and *in vivo,* the Meeting concluded that fenitrothion is unlikely to be genotoxic. It also concluded that fenitrothion is unlikely to pose a carcinogenic risk to humans.

In multigeneration studies of reproductive toxicity in rats, the treatment-related effects of fenitrothion were cholinergic signs at high doses and reductions in food consumption and body-weight gain. These effects were consistent with those seen in short- and long-term studies of toxicity. Pups had reduced body weight, viability, and lactation indices. The NOAEL for reduced food consumption and body-weight gain in dams was 0.65 mg/kg bw per day. The NOAEL for toxicity in offspring was 3.1 mg/kg bw per day, the effects being seen at maternally toxic doses.

In studies of developmental toxicity in rats and rabbits, the maternal effects were cholinergic signs and reduced body-weight gain (NOAEL, 8 mg/kg bw per day in rats and 10 mg/kg bw per day in rabbits). No fetal toxicity was observed at the highest dose tested (NOAEL, 25 mg/kg bw per day in rats and 30 mg/kg bw per day in rabbits); there was no evidence of treatment-induced malformations in any of the studies.

In studies of delayed neurotoxicity, fenitrothion was given to chickens as a single acutely toxic dose. There was no evidence that it caused delayed neurotoxicity, and the incidence of histopathological lesions in the nerve tissues of birds treated once at 500 mg/kg bw was not increased. In rats given single doses of fenitrothion of up to 200 mg/kg bw by gavage or as repeated doses of up to 18 mg/kg bw per day in the diet for 13 weeks, there were no treatment-related neurological lesions or effects on cognition and no inhibition of neuropathy target esterase activity, although cholinergic signs and significant inhibition of erythrocyte and brain cholinesterase activity were seen at a number of doses. In these studies, which included a functional observational battery of tests, clinical signs of intoxication were observed. However, cholinergic signs were observed only when brain cholinesterase activity was inhibited by more than 58% or when erythrocyte acetylcholinesterase activity was inhibited by more than 38%.

Fenitrothion did not induce immunotoxicity in a series of immunological tests.

Although a published report on ocular effects indicated that a single oral dose of 14 mg/kg bw administered to male rats caused significant electroretinographic changes after 2 days, this could not be confirmed in rats given either a single dose of up to 400 mg/kg bw by gavage or repeated daily doses of 2.0 mg/kg bw in the diet for 13 weeks.

When fenitrothion was given to 24 volunteers as a single oral dose of 0.042–0.33 mg/kg bw, there were no cholinergic signs and erythrocyte acetylcholinesterase activity was not significantly inhibited. However, one person given 0.33 mg/kg bw showed a reduction of 28% in plasma cholinesterase activity. With repeated doses of 0.04–0.08 mg/kg bw per day for 4 days, the cholinesterase activities in erythrocytes and plasma were unchanged. In another study, fenitrothion given to two to four volunteers as a divided daily oral dose of 0.18 or 0.36 mg/kg bw per day for 4 days did not induce cholinergic signs or changes in cholinesterase activity in erythrocytes or plasma.

In a retrospective hospital-based study of 16 cases of poisoning with fenitrothion requiring extensive, aggressive antidotal therapy, 7 of 10 survivors had symptoms consistent with ‘intermediate syndrome’, namely delayed onset (24–96 h) of muscular weakness affecting the muscles of the neck, proximal limb, and respiratory system. No plasma cholinesterase activity was detectable at the time of admission of the patients, and the recovery time ranged from 5 to more than 10 weeks.

The Meeting concluded that the existing database was adequate to characterize the potential hazard of fenitrothion to fetuses, infants, and children. Although fenitrothion is known to be neurotoxic to adults, the Meeting did not recommend that a study of developmental neurotoxicity be conducted, since there was no evidence of increased neurotoxicity in offspring exposed pre- or postnatally, when compared with adults in the same experiment.

The Meeting affirmed the ADI of 0–0.005 mg/kg bw that was established by the 1988 Joint Meeting, which was based on a NOAEL of 0.5 mg/kg bw per day for inhibition of brain and erythrocyte cholinesterase activity in a 2-year study of toxicity in rats and a safety factor of 100. This was supported by a NOAEL of 0.57 mg/kg bw per day for inhibition of brain and erythrocyte cholinesterase activity in a 3-month study of ocular toxicity in rats and a NOAEL of 0.65 mg/kg bw per day for reduced food consumption and body-weight gain in a study of reproductive toxicity in rats. The 4-day study in volunteers was not considered suitable for establishing an ADI because of its short duration and the associated absence of steady-state kinetics.

The Meeting allocated an acute RfD of 0.04 mg/kg bw to fenitrothion on the basis of a NOAEL of 0.36 mg/kg bw for inhibition of erythrocyte acetylcholinesterase activity in a study in volunteers and a safety factor of 10.

A toxicological monograph was prepared, summarizing data received since the previous evaluation and including relevant data from previous monographs and monograph addenda.

Levels relevant for risk assessment

Species	Study	Effect	NOAEL	LOAEL
Mouse	104-week study of toxicity and carcinogenicity[a]	Toxicity	10 ppm, equal to 1.4 mg/kg bw per day	100 ppm, equal to 13 mg/kg bw per day
		Carcinogenicity	1000 ppm, equal to 140 mg/kg bw per day[b]	–
Rat	104-week study of toxicity and carcinogenicity[a]	Toxicity	10 ppm, equal to 0.5 mg/kg bw per day	30 ppm, equal to 1.5 mg/kg bw per day
		Carcinogenicity	100 ppm, equal to 6.5 mg/kg bw per day[b]	–
	Two-generation study of reproductive toxicity[a]	Parental toxicity	10 ppm, equal to 0.65 mg/kg bw per day	40 ppm, equal to 3.1 mg/kg bw per day
		Pup toxicity	40 ppm, equal to 3.1 mg/kg bw per day	120 ppm, equal to 9.6 mg/kg bw per day
	Developmental toxicity[c]	Maternal toxicity	8 mg/kg bw per day	25 mg/kg bw per day
		Embryo- and fetotoxicity	25 mg/kg bw per day[b]	–
	Acute neurotoxicity[c]		12.5 mg/kg bw	50 mg/kg bw
Rabbit	Developmental toxicity[c]	Maternal toxicity	10 mg/kg bw per day	30 mg/kg bw per day
		Embryo- and fetotoxicity	30 mg/kg bw per day[b]	–
Dog	1-year study of toxicity[a]	Toxicity	50 ppm equal to 1.6 mg/kg bw per day[b]	–
Human	4-day study of toxicity[d]	Toxicity	0.36 mg/kg bw per day[b]	–

[a] Dietary administration
[b] Highest dose tested
[c] Gavage
[d] Capsule

Estimate of acceptable daily intake for humans

0–0.005 mg/kg bw

Estimate of acute reference dose

0.04 mg/kg bw

Studies that would provide information useful for continued evaluation of the compound

- Further observations in humans

Summary of critical end-points

Absorption, distribution, excretion, and metabolism in mammals	
Rate and extent of oral absorption	About 90–100% in rats within 72 h About 70% in humans in 96 h
Dermal absorption	About 45% after 24 h in rats
Distribution	Initially widely distributed; highest concentrations of residues in liver, kidneys, and fat at 48 h in rats

Potential for accumulation	Elimination half-time, 2–4.5 h in humans. No evidence of potential for accumulation in rats
Rate and extent of excretion	> 95% within 72 h in rats, mainly in urine (68–93%) and less in faeces (6–15%)
Metabolism in animals	Rapidly activated and deactivated
Toxicologically significant compounds (animals, plants, and environment)	Parent compound, oxon derivative, and 3-methyl-4-nitrophenol
Acute toxicity	
Rat, LD_{50}, oral	240 mg/kg bw (range, 240–1700 mg/kg bw)
Rat, LD_{50}, dermal	890 mg/kg bw (range, 890–5000 mg/kg bw)
Rat, LC_{50}, inhalation	2.2 mg/l (4 h; aerosol, 0.59–0.82-mm particles; whole-body exposure)
Dermal irritation	Not irritating in rabbits
Ocular irritation	Not irritating in rabbits
Dermal sensitization	Not a sensitizer in guinea-pigs
Short-term toxicity	
Target/critical effect	Inhibition of brain cholinesterase activity
Lowest critical oral NOAEL	1.3 mg/kg bw per day, rat, 13 weeks
Lowest relevant dermal NOAEL	3 mg/kg bw per day, rabbits; 21 days
Lowest relevant inhalation NOAEC	Not established; LOAEC = 0.2 mg/l per day, rat; 13 weeks
Genotoxicity	Not genotoxic
Long-term toxicity and carcinogenicity	
Target/critical effect	Inhibition of brain cholinesterase activity
Lowest relevant NOAEL	0.5 mg/kg bw per day, rat, 2 years
Carcinogenicity	Not carcinogenic in rats or mice
Reproductive toxicity	
Reproduction target/critical effect	No reproductive toxicity at the highest dose tested in rats
Relevant reproductive NOAEL	3.1 mg/kg bw per day; two-generation study in rats
Developmental target/critical effect	No fetal developmental toxicity at maternally toxic doses
Lowest relevant developmental NOAEL	25 mg/kg bw per day; rats
Neurotoxicity/Delayed neurotoxicity	Reversible neurotoxicity consistent with cholinesterase inhibition No evidence of delayed neurotoxicity or of histopathological changes in nerves of hens (500 mg/kg bw) or rats (200 mg/kg bw or 17.6 mg/kg bw per day for 13 weeks)
Other toxicological studies	No immunotoxicity or ocular toxicity
Medical data	No inhibition of erythrocyte acetylcholinesterase activity in volunteers after either a single oral dose of up to 0.33 mg/kg bw or repeated oral doses of up to 0.36 mg/kg bw per day for 4 days Poisoning cases presented with severe cholinergic effects followed by evidence of 'intermediate syndrome'

Summary	***Value***	***Study***	***Safety factor***
ADI	0–0.005 mg/kg bw	Rat, 2-year, dietary	100
Acute RfD	0.04 mg/kg bw	Human, repeated doses	10

Dietary risk assessment

The estimated theoretical maximum daily intakes from the five GEMS/Food regional diets, on the basis of existing MRLs, represented 290–1400% of the ADI (Annex 3). The dietary intake estimates will be refined further during the periodic review of residues of fenitrothion.

4.12 Fenthion (039)

Residue and analytical aspects

Fenthion was first evaluated by the Joint Meeting in 1971 and has been reviewed several times since, most recently in 1995 within the periodic review programme of the CCPR. On the basis of data on residues found in supervised trials, the 1995 JMPR agreed to withdraw the previous recommendations for all MRLs except those for for cherries, olives, and husked rice, which were confirmed. The 1995 JMPR recommended new MRLs for mandarins and sweet and sour oranges, replacing the existing MRL for citrus fruit, and amended the MRL for virgin olive oil.

At its twenty-ninth session, the CCPR decided to retain the Codex MRLs for meat and milk for 4 years until data from animal feeding studies became available. At its thirtieth session, the CCPR noted that ingestion of up to 200 ml of virgin olive oil containing fenthion residues at the MRL would not exceed the acute RfD of 0.01 mg/kg bw. The Committee recognized that new GAP for olives was being developed within the European Union and, consequently, new data were to be expected. At its thirty-first session, the CCPR was informed that the results of animal feeding studies and new data on olives, oranges, and mandarins would be available for the 2000 JMPR. The CCPR decided to retain the draft MRLs for mandarins and sweet and sour oranges to Step 7 (7B) until the residue evaluation of the 2000 JMPR became available. At its thirty-second session, the CCPR was informed that the results of animal feeding studies had been provided to the 2000 JMPR and agreed to extend the 4-year extension for the MRLs for meat and milks, pending the review of the 2000 JMPR.

The 1995 JMPR considered that it would be desirable to have full details of the trials on olives conducted in Greece and additional information on residues in treated animal feeds and in meat and offal from animals treated externally or which had consumed fenthion-treated feeds in transfer studies. Information on the measured octanol–water partition coefficients of the oxidative metabolites of fenthion was also considered desirable.

The manufacturer provided new studies of residues in peaches and olives, to support pending GAP within the European Union, and data on cherries from a trial conducted in Germany in 1968 which had been submitted to the Meeting previously. These data were not considered, as the related GAP in the European Union is pending. In addition, information on current GAP, the fate of residues during the processing of peaches, apples, and olives, octanol–water partition coefficients for the oxidative metabolites, methods of analysis for residues, an animal transfer study, and residues in food in commerce or at consumption were provided. Information on national MRLs and GAP were provided by Australia, Germany and The Netherlands.

Octanol–water partition coefficients

The manufacture submitted data on the octanol–water partition coefficients of fenthion, fenthion sulfoxide, and fenthion sulfone. The log P_{OW} for fenthion is 4.04 and 4.06 at *n*-octanol:water ratios of 1 and 0.1, respectively. The two metabolites are polar, with log P_{OW} values for fenthion sulfoxide of 1.98 and 1.93 and for fenthion sulfone of 2.02 and 2.17 at *n*-octanol:water ratios of 1 and 0.1, respectively.

Residues in animal commodities

Exposure to fenthion residues may occur during consumption of rice. In the evaluation of fenthion use in rice made by the Meeting in 1995, the concentrations of total fenthion residues in rice in the trials conducted according to GAP (median values in italics) were: < 0.001 (17 trials), < 0.002 (2 trials), 0.008, 0.009, 0.01 (2 trials), 0.012, < *0.014* (8 trials), < *0.015* (17 trials), < 0.016 (2 trials), < 0.017, 0.018, < 0.019 (2 trials), < 0.02, < 0.023, < 0.024 (5 trials), and < 0.028 (2 trials) mg/kg. The current Meeting estimated a STMR value of 0.0145 mg/kg.

The Meeting received data on the processing of oranges, which could have been used to assess the dietary burden from consumption of dried orange pulp; however, residues for this animal feed commodity were not determined, and the report was submitted as a summary. The Meeting decided that it was inadequate.

The Meeting considered that husked rice is a minor animal feed commodity and is therefore not suitable for calculating the dietary burden of fenthion residues in farm animals.

A study of transfer of fenthion residues in lactating dairy cows was made available to the Meeting. Encapsulated fenthion was given for 28 days to groups of three cows at a dose of 0.075, 0.23, or 0.75 mg/kg bw. The only edible tissues in which residues of fenthion were detected were liver and composite fat, and only in cows at the highest dose. In liver, the concentration of residues ranged from < 0.05 to 0.07 mg/kg. In composite fat (perirenal, omental, subcutaneous), the concentration ranged from < 0.05 to 0.12 mg/kg. The concentrations in kidney and composite muscle (round, flank, loin) were below the LOQ of 0.05 mg/kg. At 0.23 mg/kg bw, the concentration of total residues in liver and composite fat was below the LOQ. Kidney and muscle of cows at this dose and all tissues of cows at 0.075 mg/kg were not analysed because no residues were expected on the basis that none were found at the higher dose. The concentration of total residues of fenthion in milk reached a plateau in the cows given 0.75 mg/kg bw within 7 days, well before the 28-day sacrifice. At the two lower doses, the concentration in milk was below the LOQ of 0.01 mg/kg.

The Meeting noted that, although the results of an animal feeding study had been submitted, the calculated dietary burden of fenthion residues in animal commodities was an underestimate. GAP exists for direct use of fenthion in animals, but data on dermal application to animals were not available. The Meeting was therefore unable to estimate maximum residue levels for fenthion in animal commodities. It confirmed the 1995 JMPR recommendation to withdraw the maximum residue levels for meat (of mammals other than marine mammals) and milk.

The Meeting received information on the fate of incurred residues of fenthion during the processing of apples, peaches, oranges, and olives, and processing factors were calculated for apples and peaches. Processing factors for olives were calculated by the 1995 JMPR. The processing data for oranges were not evaluated as the report submitted was inadequate.

Dietary risk assessment

Chronic intake

STMR values were estimated by the present Meeting for husked rice. When data on consumption were available, the STMR value was used with the existing MRLs and draft MRLs for six other food commodities in estimating dietary intake.

The dietary intakes from the five GEMS/Food regional diets, based on new and existing STMR values and MRLs, represented 1–12% of the ADI. The Meeting concluded that the dietary

intake of fenthion residues would not exceed the ADI in any GEMS/Food regional diet (Annex 3). The estimates of dietary intake will be further refined during the next periodic review of residues.

Short-term intake

The acute RfD for fenthion established by the present Meeting is 0.01 mg/kg bw. The IESTIs for husked rice (Annex 3) was 0.0009 mg/kg bw (1% of the acute RfD) for aduts and 0.00018 mg/kg bw (2% of the acute RfD) for children. The Meeting concluded that it is highly unlikely that the short-term intake of fenthion would exceed the acute RfD. The lack of STMR values, except for husked rice, for fenthion in food commodities precluded a risk assessment for short-term intake, which will be assessed during the next periodic review of residues.

4.13 Fipronil

Toxicological evaluation

Fipronil and some of its metabolites and degradation products were first evaluated by the Joint Meeting in 1997, when an ADI of 0–0.0002 mg/kg bw was established on the basis of a NOAEL of 0.019 mg/kg bw per day in a 2-year study of toxicity and carcinogenicity in rats and a safety factor of 100.

The Meeting also considered whether a separate ADI should be established for fipronil-desulfinyl, a photodegradation product of fipronil, on the basis that it could be a significant residue, and its toxicity appeared to be greater than that of the parent molecule, fipronil. A temporary ADI of 0–0.00003 mg/kg bw was established for fipronil-desulfinyl on the basis of a NOAEL of 0.029 mg/kg bw per day in a 90-day study in rats and a safety factor of 1000, in view of the lack of a long-term study by oral administration in rats and a study of neurotoxicity in rats given repeated oral doses. Studies with fipronil-desulfinyl that were required for the present Meeting included: a short-term study of neurotoxicity in rats, a study of developmental neurotoxicity in rats, and the results of an ongoing long-term study of toxicity in rats. The following information was available on fipronil-desulfinyl for consideration by the present Meeting: metabolism in goats and hens, data on clinical signs of neurotoxicity (aggressivity, irritability) in historical control groups of mice and rats, and the results of a long-term study of toxicity and carcinogenicity in rats. Studies with the parent fipronil included a study of acute neurotoxicity in rats and a 6-week study of toxicity in mice treated orally. In addition, several studies were submitted on metabolites and photodegradation products, including the toxicity of single oral doses and induction of reverse mutation by sulfonofipronil amide, an environmental degradation product, and fipronil carboxylic acid, an environmental degradation product , and a 28-day study of toxicity with orally administered fipronil destrifluoromethyl sulfonate, an environmental degradation product. The structures of fipronil and the metabolites and environmental degradation products that were reviewed by the present Meeting are provided in Figure 1.

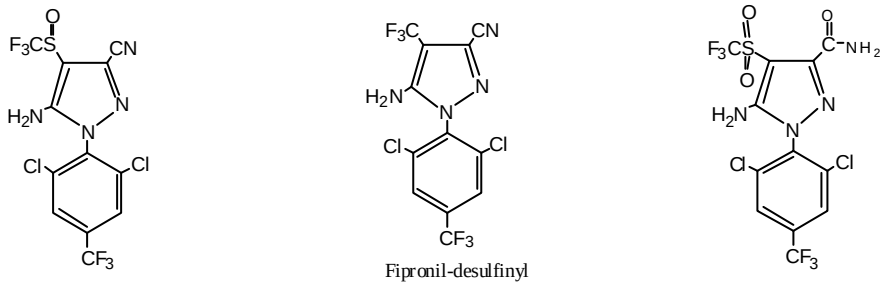
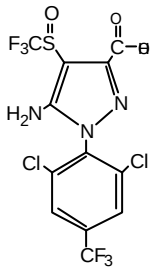
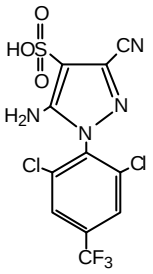


Figure 1. Structures of fipronil and some of its metabolites and environmental degradation products



Fipronil carboxylic acid



Fipronil destrifluoromethyl sulfonate

Fipronil

In a study of neurotoxicity, fipronil was administered by gavage to rats at a single oral dose of 0, 2.5, 7.5, or 25 mg/kg bw. Decreased hind-foot splay was observed in males at 7.5 and 25 mg/kg bw 7 h after dosing, and females at these doses showed decreased grooming and decreased body-weight gain, food consumption, and food efficiency. The NOAEL was 2.5 mg/kg bw. In another study of neurotoxicity reviewed by the 1997 JMPR, the NOAEL was 0.5 mg/kg bw on the basis of decreased hindleg splay 7 h after treatment at 5 mg/kg bw.

In a range-finding study, fipronil was administered in the diet to mice at a concentration of 0, 15, 40, 110, 300, or 800 ppm for 6 weeks. One female at 40 ppm showed clinical signs of neurotoxicity (overactivity and irritability), which were observed consistently in males and females at higher doses. Body weight and food consumption were decreased in males at 15 ppm and above. The absolute and/or relative weights of the liver were increased in males and females at 15 ppm and above. As this was a range-finding study, the maximum tolerated dose for a long-term study was considered to be 15–40 ppm, equal to 2.4–6.5 mg/kg bw per day.

Fipronil-desulfinyl

In a study evaluated by the 1997 JMPR, fipronil-desulfinyl was administered in the diet of mice for 90 days at a concentration of 0, 0.5, 2, or 10 ppm. The study was re-evaluated by the present Meeting in the light of additional information on the incidence of key toxicological findings in historical controls. The Meeting concluded that the NOAEL was 0.5 ppm, equal to 0.08 mg/kg bw per day.

In a 90-day study of toxicity in rats, also evaluated by the 1997 JMPR, fipronil-desulfinyl was administered in the diet at a concentration of 0, 0.5, 3, 10, or 30 ppm. The NOAEL was considered to be 0.5 ppm, equal to 0.029 mg/kg bw per day. The study was re-evaluated by the present Meeting in the light of additional information on the incidence of key toxicological findings in historical controls. The present Meeting concluded that, in view of comparable incidences of clinical signs in historical controls and the lack of clinical signs at comparable doses after 90 days of treatment in the long-term study of toxicity and carcinogenicity, the NOAEL was 3 ppm, equal to 0.18 mg/kg bw per day.

In a long-term study of toxicity and carcinogenicity, fipronil-desulfinyl was administered in the diet to rats at a concentration of 0, 0.5, 2, or 10 ppm for 104 weeks. The 10 ppm concentration was reduced to 6 ppm in females after week 26 owing to an increased mortality rate. The incidences of clinical signs of neurotoxicity (tonic and/or clonic convulsions) in females were 7.1% in controls, 11% at 0.5 ppm, 19% at 2 ppm, and 29% at 10 ppm. These were statistically significant ($p < 0.05$) at the two higher doses but not at 0.5 ppm. The Meeting noted that the incidences in control females and those at 0.5 ppm fell within the range (2.5–16%) for historical control rats obtained from the same

source at around the time of the study. The NOAEL for toxicity was 0.5 ppm, equal to 0.025 mg/kg bw per day, on the basis of clinical signs of toxicity. There was no evidence of carcinogenicity at doses considered adequate to measure the carcinogenic potential of fipronil-desulfinyl. The Meeting noted that there was no study of the carcinogenicity of fipronil-desulfinyl in mice; however, fipronil-desulfinyl did not produce thyroid tumours in rats as does the parent compound fipronil. Furthermore, the short-term studies provided no evidence of disruption of thyroid homeostasis, as was found with fipronil. There was no evidence of genotoxicity in three assays *in vitro* (for reverse mutation, gene mutation, and chromosomal aberration). The Meeting concluded that fipronil-desulfinyl is unlikely to pose a carcinogenic risk to humans.

Fipronil metabolites and degradation products

The LD_{50} value for both sulfonofipronil amide and fipronil carboxylic acid was > 2000 mg/kg after oral administration. Neither compound induced reverse mutation in bacteria, either with or without metabolic activation.

Fipronil destrifluromethyl sulfonate was administered in the diet to rats at a concentration of 0, 50, 500, 5000, or 10 000 ppm for 28 days. The triglyceride concentration was increased in females and alkaline phosphatase activity in animals of each sex at 5000 ppm, equal to 460 mg/kg bw per day. The NOAEL was 500 ppm, equal to 45 mg/kg bw per day.

Conclusion

The present Meeting concluded that the NOAELs in the long-term studies of toxicity and carcinogenicity with fipronil and fipronil-desulfinyl, both based on clinical signs of neurotoxicity, were comparable. The Meeting therefore established a group ADI of 0–0.0002 mg/kg bw for fipronil and fipronil-desulfinyl, in accordance with that established for fipronil in 1997. This value is supported by the NOAEL of 0.025 mg/kg bw per day for fipronil-desulfinyl in the long-term study of toxicity and carcinogenicity in rats, with a safety factor of 100.

In addition, comparison of the NOAEL for the developmental toxicity of fipronil-desulfinyl in rats (1 mg/kg bw per day) with the NOAEL in the long-term study of toxicity and carcinogenicity (0.025 mg/kg bw per day) shows a 40-fold difference. Use of the NOAEL in the long-term study of toxicity and carcinogenicity in establishing the ADI for fipronil-desulfinyl would therefore protect developing organisms. The Meeting concluded that the additional studies of neurotoxicity (short-term study of neurotoxicity and developmental neurotoxicity) required by the 1997 JMPR were no longer necessary.

The acute RfD established by the 1997 JMPR was 0.003 mg/kg bw for both fipronil and fipronil-desulfinyl, on the basis of the NOAEL of 0.3 mg/kg bw per day in a study of neurotoxicity in rats given repeated doses of fipronil, and a safety factor of 100. The present Meeting confirmed this as a group acute RfD for fipronil and fipronil-desulfinyl, alone or in combination.

A monograph addendum was prepared, summarizing the data reviewed by the present Meeting.

Levels relevant for risk assessment of fipronil-desulfinyl

Species	Study	Effect	NOAEL	LOAEL
Rat	104-week study of toxicity and carcinogenicity[a]	Toxicity	0.5 ppm, equal to 0.025 mg/kg bw per day[b]	2 ppm, equal to 0.098 mg/kg bw per day
		Carcinogenicity	10 ppm, equal to 0.497 mg/kg bw per day	–

	Developmental toxicity[c]	Maternal toxicity	1 mg/kg bw per day	2.5 mg/kg bw per day
		Embryo- and fetotoxicity	1 mg/kg bw per day	2.5 mg/kg bw per day
Species	Study	Effect	NOAEL	LOAEL
Dog	90-day study of toxicity[a]	Toxicity	9.5 ppm, equal to 0.29 mg/kg bw per day	35 ppm, equal to 0.95 mg/kg bw per day

[a] Dietary administration
[b] Highest dose tested
[c] Gavage administration

Estimate of acceptable daily intake for humans

0–0.0002 mg/kg bw (for fipronil and fipronil-desulfinyl, alone or in combination)

Estimate of acute reference dose

0.003 mg/kg bw (for fipronil and fipronil-desulfinyl, alone or in combination)

Studies that would provide information useful for further evaluation of the compound

- Observations in humans

Summary of critical end-points

Absorption, distribution, excretion, and metabolism in mammals	
Rate and extent of oral absorption	Slowly absorbed: maximum blood concentration 46–73 h after dosing
Dermal absorption	0.2–7% of applied dose within 24 h
Distribution	Widely distributed in tissues
Potential for accumulation	Long half-time (183–195 h) and high fat:plasma ratios suggest potential bioaccumulation
Rate and extent of excretion	70% eliminated within 96–120 h after dosing
Metabolism in animals	Extensive metabolism; numerous metabolites in urine and faeces
Toxicologically significant compounds (animals, plants and environment)	Fipronil, fipronil-desulfinyl, fipronil sulfone, and fipronil thioether
Acute toxicity	
Rat, LD_{50}, oral	Males: 18 mg/kg; females: 15 mg/kg
Rat, LD_{50}, dermal	> 2000 mg/kg
Rat, LC_{50}, inhalation	–
Dermal irritation	–
Ocular irritation	–
Dermal sensitization	–
Short-term toxicity	
Target/critical effect	Clinical signs of neurotoxicity
Lowest relevant oral NOAEL	0.08 mg/kg bw per day (90-day dietary study in mice)
Lowest relevant dermal NOAEL	–
Lowest relevant inhalation NOAEL	–
Genotoxicity	No evidence of genotoxicity
Long-term toxicity and carcinogenicity	

Target/critical effect	Clinical signs of neurotoxicity
Lowest relevant NOAEL	0.025 mg/kg bw per day
Carcinogenicity	Not carcinogenic
Reproductive toxicity	
Reproductive target/critical effect	–
Lowest relevant reproductive NOAEL	–
Developmental target/critical effect	Increased incidence of incomplete or reduced ossification of several bones
Lowest relevant developmental NOAEL	1.0 mg/kg bw per day
Neurotoxicity/Delayed neurotoxicity	Evidence of neurotoxicity in several studies
Other toxicological studies	None
Medical data	None

Summary	***Value***	***Study***	***Safety factor***
ADI	0–0.0002 mg/kg bw (for fipronil and fipronil-desulfinyl, alone or in combination)	2-year study of toxicity and carcinogenicity in rats with fipronil	100
Acute RfD	0.003 mg/kg bw (for fipronil and fipronil-desulfinyl, alone or in combination)	Study of neurotoxicity in rats given repeated doses	100

4.14 Imazalil (110)

Toxicological evaluation

Imazalil was evaluated by the Joint Meeting in 1977, when a temporary ADI of 0–0.01 mg/kg bw was allocated. The compound was reviewed again in 1986, when an ADI of 0–0.01 mg/kg bw was allocated on the basis of the NOAEL in a 2-year study in dogs. The compound was re-evaluated in 1991, when a new study in dogs was available: an ADI of 0–0.03 mg/kg bw was established on the basis of the NOAEL in the study in dogs and a 100-fold safety factor.

Imazalil is used as a human and veterinary pharmaceutical, the INN name being enilconazole (*Pesticide Manual*, 1994); it has not been evaluated by the JECFA. Imazalil was reviewed by the present Meeting within the periodic review programme of the CCPR.

After oral administration to rats, [^{14}C]imazalil was rapidly and nearly completely absorbed. Most of the label was excreted within 96 h, predominantly in the urine but also in faeces. Nearly 50% of the radiolabel retained in the body was found in the liver. Very little imazalil was excreted unchanged, and the compound was metabolized to at least 25 metabolites. The main routes of metabolism were epoxidation, epoxide hydration, oxidative *O*-dealkylation, imidazole oxidation and scission, and oxidative *N*-dealkylation. No significant sex difference was seen in metabolism. The metabolic pattern was similar after oral and intravenous administration.

In a study of the hepatotoxicity of imazalil, the compound was found to affect liver morphology (vacuolation) when given in the diet to mice for up to 3 months. In rats, imazalil caused fatty infiltration of the liver and decreased serum concentrations of triglycerides, cholesterol, and phospholipids. Imazalil administered to mice by mouth induced the cytochrome P450 isoenzymes CYP1A, CYP2B, CYP2C, and CYP3A. Imazalil had no significant estrogenic effect when tested *in vitro* in an MCF7 cell proliferation assay or a yeast estrogen screen. Steroid 11b-hydroxylation and 19-

hydroxylation in the mitochondria of the gerbil were reported to be substantially suppressed in parallel by imazalil. Imazalil inhibited CYP19 aromatase activity in human placental microsomes.

The acute oral LD_{50} of imazalil in rats was 200–350 mg/kg bw. Imazalil was not irritating to the skin of rabbits and was moderately irritating to the eye. It had weak sensitizing potential when tested according to the Magnusson and Kligman method. A single case report of contact dermatitis in humans in response to imazalil was found. A further report was considered, in which imazalil had been used orally at high doses by an individual to treat a fungal infection; it was well tolerated, the only adverse effect noted being nausea. Imazalil has been classified by WHO as moderately hazardous.

Studies in mice, rats, and dogs showed that the target organ of toxicity was frequently the liver. In addition, imazalil, like other azole fungicides, affects steroid synthesis, but there was little indication that this was manifested *in vivo* in the studies examined by the Meeting.

Imazalil was applied to the shaved backs of New Zealand white rabbits at a dose of 0, 10, 40, or 160 mg/kg bw per day for 6 h/day, 5 days/week for 3 weeks, on a porous gauze dressing. The highest dose reduced the creatinine concentration, specific gravity, and urobilinogen concentration in urine. The NOAEL was 40 mg/kg bw per day.

Imazalil was administered to groups of 10 rats of each sex at a dietary concentration of 0, 25, 100, or 400 ppm. The NOAEL was 100 ppm (equivalent to 5 mg/kg bw per day), on the basis of increased relative kidney weights in males and increased absolute and relative liver and kidney weights and increased absolute thymus weight in females at the highest concentration.

In a 1-year study of toxicity in beagle dogs, groups of four animals of each sex received imazalil at a dose of 0, 1.2, 2.5, or 20 mg/kg bw per day orally in gelatine capsules. The NOAEL was 2.5 mg/kg bw per day on the basis of clinical signs, decreased body-weight gain and food consumption, decreased serum calcium concentration, increased alkaline phosphatase activity, and increased liver weight at the highest dose.

In a 23-month study of carcinogenicity in mice, groups of 50 males and 50 females received imazalil at a dietary concentration of 0, 50, 200, or 600 ppm. Males at the two higher doses and females at the highest dose showed focal cellular changes, large and small vacuoles, and pigmented and swollen sinusoidal cells in the liver. Increased incidences of hepatic neoplasms were found in males at 200 and 600 ppm, with increased incidences of hepatic neoplastic nodules; a similar increase in the incidence of hepatic neoplasms was found in females at the highest dietary concentration. The hepatic neoplasms were evaluated three times, the last time by a pathology working group which concluded that the incidence of adenomas, but not that of carcinomas, was increased in males at the two highest doses. Therefore, the NOAEL for carcinogenicity was 50 ppm. The overall NOAEL for the study was 50 ppm, equal to 8.1 mg/kg bw per day, on the basis of morphological changes (adenomas, foci and nodules) in the livers of males at 200 ppm.

Imazalil was administered to groups of 20 male and 20 female rats at a dietary concentration of 0, 25, 100, or 400 ppm for 18 months. Decreased body-weight gain was observed in females at the highest dose, and males at this dose showed treatment-related gross (increase in the lobular pattern) and microscopic (periportal cytoplasmic vacuolation of hepatocytes) effects in the liver. There was no evidence of treatment-related neoplasia. The NOAEL was 100 ppm, equivalent to 5 mg/kg bw per day, on the basis of decreased body-weight gain in females, decreased plasma albumin concentration in males, and pathological changes in the livers of males at the highest dose.

Imazalil was administered to groups of 50 male and 50 female rats at a dietary concentration of 0, 25, 100, or 400 ppm for 30 months. The NOAEL was 100 ppm, equal to 3.6 mg/ kg bw per day, on the basis of decreased body-weight gain in males at the highest dose. No treatment-related histopathological effects were observed in the liver. There was no evidence that imazalil was carcinogenic.

Imazalil has been tested for genotoxicity in an adequate range of tests *in vivo* and *in vitro*. The Meeting concluded that imazalil is unlikely to have genotoxic potential. In view of the lack of genotoxicity and the finding of tumours only in mice, the Meeting concluded that imazalil is unlikely to pose a carcinogenic risk to humans. However, the Meeting was aware that the toxicological dossier supplied was incomplete.

A two-generation study of reproductive toxicity was conducted in rats, in which imazalil was administered in the diet at a nominal dose of 0, 5, 20, or 80 mg/kg bw per day. The NOAEL for maternal toxicity was 20 mg/kg bw per day on the basis of reduced maternal weight gain at 80 mg/kg bw per day. Decreased numbers of live pups and increased numbers of stillbirths were observed at this dose. The survival rate of pups during lactation was decreased in all test groups of the F_1 generation at days 4, 14, and 21 of lactation and in the F_2 generation, at 5 mg/kg bw per day (days 14 and 21) and 80 mg/kg bw per day (days 4, 14, and 21). However, when these data were evaluated on a per litter basis, the differences in survival were not significant. On this basis, the NOAEL for fetotoxicity was 20 mg/kg bw per day.

A study of reproductive toxicity in which neurobehavioural end-points were measured was conducted with dietary concentrations of 0, 120, 240, and 480 ppm. The lowest concentration used was high in comparison with the doses used in other studies that were reviewed. Nevertheless, the results suggest that neurobehavioural end-points in the offspring of mice exposed to imazalil in their diet, during pregnancy and perinatally, can be adversely affected. In view of the inconsistent results found at the lowest dose, the multiple end-points measured, and the lack of a dose–response relationship, the Meeting concluded that the NOAEL for developmental neurotoxicity was 120 ppm, equal to 20 mg/kg bw per day.

Two studies of the developmental toxicity of imazalil in mice were available for review. In the first, imazalil was administered by gavage at a dose of 0, 40, 80, or 120 mg/kg bw per day. The NOAEL for maternal toxicity was 40 mg/kg bw per day, on the basis of reduced body-weight gain and food consumption. No NOAEL was identified for fetal toxicity, as litter size and the number of live pups were decreased in all groups. In the second study, imazalil was administered by gavage at a dose of 0, 10, 40, 80, or 120 mg/kg bw per day. At the highest dose, the number of live fetuses was reduced, and the number of resorptions was increased. The body weights of pups at this dose were decreased, but the sex ratio was similar in all groups. The NOAEL for maternal toxicity was 10 mg/kg bw per day on the basis of decreased body-weight gain at 40 mg/kg bw per day and reduced food consumption after dosing. In addition, deaths occurred at doses of 80 mg/kg bw per day and above. The NOAEL for fetal toxicity was 80 mg/kg bw per day, as the highest dose reduced the number of live fetuses,increased the number of resorptions, and decreased the body weights of the pups. There was no evidence of teratogenicity. When the two studies were considered together, the Meeting concluded that the NOAEL for maternal toxicity was 10 mg/kg bw per day, but that a NOAEL for fetal toxicity could not be identified.

In a study of developmental toxicity in rats, imazalil was administered at a dose of 0, 40, 80, or 120 mg/kg bw per day by gavage. No teratogenic effects were seen, and the NOAEL for fetal toxicity was 40 mg/kg bw per day, on the basis of reduced pup weight at the higher dose. A NOAEL for maternal toxicity was not identified because of decreased maternal body weight in all the groups when compared with concurrent controls.

The developmental toxicity of imazalil in rabbits was studied at doses of 0, 1.2, 2.5, and 5 mg/kg bw per day. The NOAEL for both maternal and fetotoxicity was 5 mg/kg bw per day, the highest dose tested. In another study of developmental toxicity in rabbits, at doses of 0, 5, 10, and 20 mg/kg bw per day, the NOAEL for maternal toxicity was 5 mg/kg bw per day on the basis of reduced food consumption at 10 and 20 mg/kg bw per day. The NOAEL for fetal toxicity was also 5 mg/kg bw per day, on the basis of an increased incidence of resorptions and a decrease in the number of live pups at 10 and 20 mg/kg bw per day. In neither case was imazalil teratogenic.

The Meeting concluded that the existing database was adequate to characterize the potential hazard of imazalil to fetuses, infants, and children

The ADI of 0–0.03 mg/kg bw established by the 1991 Joint Meeting was reaffirmed. The ADI is based on a NOAEL of 2.5 mg/kg bw per day in a 1-year study of toxicity in dogs and a 100-fold safety factor.

The establishment of an acute RfD was considered unnecessary as no relevant end-point was identified.

A toxicological monograph was prepared, summarizing the data received since the previous evaluation and some studies included in previous monographs and monograph addenda.

Levels relevant for risk assessment

Species	Study	Effect	NOAEL	LOAEL
Mouse	23-month study of toxicity and carcinogenicity[a]	Toxicity	50 ppm, equal to 8.1 mg/kg bw per day	200 ppm, equal to 33 mg/kg bw per day
		Carcinogenicity	50 ppm, equal to 8.1 mg/kg bw per day	200 ppm, equal to 33.4 mg/kg bw per day
	Developmental toxicity[b]	Maternal toxicity	10 mg/kg bw per day	40 mg/kg bw per day
		Embryo- and feto-toxicity	–	10 mg/kg bw per day[c]
Rat	30-month study of toxicity and carcinogenicity[a]	Toxicity	100 ppm, equal to 3.6 mg/kg bw per day	400 ppm, equal to 15 mg/kg bw per day
		Carcinogenicity	400 ppm, equal to 15 mg/kg bw per day[d]	
	Two-generation study of reproductive toxicity[a]	Maternal toxicity	20 mg/kg bw per day	80 mg/kg bw per day
		Pup toxicity	20 mg/kg bw per day	80 mg/kg bw per day
	Developmental toxicity[b]	Maternal toxicity	–	40 mg/kg bw per day[c]
		Embryo- and feto-	40 mg/kg bw per day	80 mg/kg bw per day toxicity
	Two-generation study of reproductive toxicity[a]	Developmental neurotoxicity	120 ppm, about 20 mg/kg bw per day	240 ppm, about 30 mg/kg bw per day
Species	Study	Effect	NOAEL	LOAEL
Rabbit	Developmental toxicity[b]	Maternal toxicity	5 mg/kg bw per day	10 mg/kg bw per day
		Embryo- and feto-	5 mg/kg bw per day	10 mg/kg bw per day toxicity
Dog	1-year study of toxicity[e]	Toxicity	2.5 mg/kg bw per day	20 mg/kg bw per day

[a] Dietary administration
[b] Gavage
[c] Lowest dose tested
[d] Highest dose tested
[e] Capsule

Estimate of acceptable daily intake for humans

0–0.03 mg/kg bw

Acute reference dose

Unnecessary

Studies that would provide information valuable for continued evaluation of the compound

- The results of the study of carcinogenicity in rats completed in 1999 and accompanying studies on mechanism of action
- Further observations in humans

Summary of critical end-points

Absorption, distribution, excretion, and metabolism in mammals	
Rate and extent of oral absorption	High bioavailability
Distribution	Extensive; highest concentration in liver
Potential for accumulation	Low
Rate and extent of excretion	Rapid: > 80% within 24 h
Metabolism in animals	Extensive metabolism by epoxidation, epoxide hydration, oxidative *O*-dealkylation, imidazole oxidation and scission, and oxidative *N*-dealkylation, rat
Toxicologically significant compounds	Parent compound
Acute toxicity	
Rats, LD_{50}, oral	220–350 mg/kg bw
Rats, LD_{50}, intraperitoneal	No data
Mice, LD_{50}, oral	No data
Dermal sensitization (test method used)	Weak response in guinea-pigs (Magnusson and Kligman)
Short-term toxicity	
Target/critical effect	Effects on body weight and food consumption
Lowest relevant oral NOAEL	2.5 mg/kg bw per day
Genotoxicity	None
Long-term toxicity and carcinogenicity	
Target/critical effect	Decreased weight gain; pathological changes in liver, mice and rats
Lowest relevant NOAEL	3.6 mg/kg bw per day
Carcinogenicity	Liver tumours in mice; clear NOAELs identified
Reproductive toxicity	
Reproduction target/critical effect	Reduced pup viability
Lowest relevant reproductive NOAEL	20 mg/kg bw per day
Developmental target/critical effect	Not teratogenic; fetotoxicity usually seen with maternal toxicity
Lowest relevant developmental NOAEL	5 mg/kg bw per day for maternal and fetal toxicity
Medical data	Used as a human drug (enilconazole) and well tolerated as such

Summary	***Value***	***Study***	***Safety factor***
ADI	0–0.03 mg/kg bw	1 year study in dogs	100
Acute RfD	None		

Dietary risk assessment

The estimated theoretical maximum daily intakes from the five GEMS/Food regional diets, based on existing MRLs, represented 10–100% of the ADI (Annex 3). The Meeting concluded that the intake of residues of imazalil resulting from uses that have been considered by the JMPR is unlikely to present a public health concern.

4.15 Malathion (049)

Residue and analytical aspects

Malathion was evaluated by the Meeting in 1999 within the periodic review programme of the CCPR. MRLs and STMR values were recommended for many crops, and the MRLs of other crops were withdrawn. No recommendation was made for wheat grain, wheat flour, or wheat wholemeal. This evaluation concerns those commodities.

In 1999, the Meeting recommended a MRL of 0.5 mg/kg and a STMR value of 0.04 mg/kg for malathion in wheat grain; the HR value found in trials was 0.28 mg/kg. A processing study conducted in wheat that was submitted to the 1999 Meeting gave processing factors of 0.23 for wheat flour and 0.41 for wheat bran. No processing factor was derived for wheat wholemeal. The 1999 Meeting concluded that it is unlikely that residues in grain would decrease after processing to bran and agreed that the processing factor of 0.41 is unrealistic.

The present Meeting recommended a MRL of 0.2 mg/kg for wheat flour, derived by multiplying the maximum residue level in wheat grain by the processing factor (0.5 mg/kg ¥ 0.23 = 0.115 mg/kg), and a STMR-P value of 0.0092 mg/kg, which corresponds to the processing factor multiplied by the recommended STMR value for wheat.

The Meeting also agreed to recommend withdrawal of the MRls for wheat bran and wheat wholemeal.

Dietary risk assessment

Chronic intake

Currently, the ADI for malathion is 0–0.3 mg/kg bw. The international estimated daily intakes from the five GEMS/Food regional diets, based on STMR values estimated by the 1999 JMPR and the STMR value for wheat flour estimated by the present Meeting, represented 0% of the ADI. The results are shown in Annex 3. The Meeting concluded that intake of residues of malathion resulting from uses that have been considered by the JMPR is unlikely to present a public heath concern.

Short-term intake

The IESTI of malathion was calculated for wheat flour. The results are shown in Annex 4. The value was 5×10^{-5} mg/kg bw for the general population and 9×10^{-5}mg/kg bw for children. As no acute RfD has been established, the acute risk assessment for malathion was not finalized.

4.16 Mevinphos (053)

Residue and analytical aspects

Mevinphos was evaluated by the Meeting in 1997 within the periodic review programme of the CCPR. The Meeting concluded that the existing MRLs for mevinphos in some crops (broccoli, Brussels sprouts, cauliflowers, citrus fruits, cucumbers, grapes, melons, peas, spinach, strawberries, and tomatoes) should be withdrawn, owing to inadequacies in the available information. At its thirty-first session, the CCPR decided to maintain the Codex MRLs for those commodities for 4 years, as the manufacturer had indicated its intention to submit new data on residues to the 2000 JMPR, except for Brussels sprouts and cauliflower. The compound was reviewed for toxicity by the Meeting in 1996, which allocated an ADI of 0–0.0008 mg/kg bw and an acute RfD of 0.003 mg/kg bw.

The present Meeting received information on analytical methods, stability under storage for tomatoes, strawberries, broccoli, lettuce, and cucumbers, the results of supervised trials on broccoli, cantaloupes, cucumbers, grapes, lemons, melons, peas, strawberries, spinach, and tomatoes, and one study of processing of lemons. Information on analytical methods, national MRLs, and residues in food in commerce were supplied by the Netherlands.

Methods of analysis

Mevinphos consists of two isomers, *E* and *Z*. In the analytical method, residues are extracted by maceration with acetonitrile, and solid sodium chloride is added for separation. The acetonitrile layer is dried with anhydrous sodium sulfate, the solvent is evaporated, and mevinphos is analysed by gas–liquid chromatography with flame photometry. The LOQs are 0.01 mg/kg for *E* plus *Z*, 0.02 mg/kg for *E*, and 0.01 mg/kg for *Z*; the recovery ranges from 69 to 108%.

Stability of residues in stored samples

Studies on the stability of residues in stored tomatoes, strawberries, broccoli, lettuce, and cucumbers were reported. Samples were fortified with mevinphos at 0.05 and 0.5 mg/kg and stored frozen (–20 °C) for 0, 1, 3, and 6 months. As complete descriptions of the studies were not provided, the data could not be evaluated.

Studies of the stability of residues in lettuce, strawberries, and turnip tops were evaluated by the Meeting in 1997. Residues were stable at about 0.68 mg/kg (*E* plus *Z*) on strawberry fruit for 4–10 months, at about 1.0 mg/kg (*E* plus *Z*) on lettuce stored frozen for 3–10 months, and at about 0.47 mg/kg on turnip tops stored for 3–10 months.

Results of supervised trials

Supervised trials on residues in lemon, strawberry, broccoli, spinach, and pea were conducted in Mexico and in the USA, where there are no registered GAP values. No relevant GAP was available to evaluate the data on these crops, and the Meeting confirmed its previous recommendation to withdraw the MRLs for citrus fruits, strawberries, broccoli, spinach, and peas.

Although supervised trials of use of mevinphos on *grape* were reported from Mexico and the USA, no data were provided on trials conducted according to GAP. The Meeting confirmed its previous recommendation to withdraw the MRL for grapes.

Although supervised trials of use of mevinphos on *melon* were reported from Mexico and the USA, no data were provided on trials conducted according to GAP. The Meeting confirmed its previous recommendation to withdraw the MRL for melons except watermelon.

Although supervised trials of use of mevinphos on *cucumber* were reported from Mexico, no data were provided from trials conducted according to GAP, and the Meeting confirmed its previous recommendation to withdraw the MRL for cucumber.

Although supervised trials of use of mevinphos on *tomato* were reported from Mexico, no data were provided from trials conducted according to GAP, and the Meeting confirmed its previous recommendation to withdraw the MRL for tomatoes.

Fate of residues during processing

One study on processing of lemons was reported. The samples were processed into fresh juice, wet pulp, dry pulp, oil, molasses, and pasteurized juice. The processing factors were 0.12 for fresh juice, 0.74 for wet pulp, 0.26 for dry pulp, and < 0.09 for oil, molasses, and pasteurized juice.

4.17 Parathion (58)

Residue and analytical aspects

Parathion was first evaluated by the Joint Meeting in 1965 and has been reviewed several times since. At its thirtieth session in 1998, the CCPR (ALINORM 99/24, Appendix VII) listed parathion for periodic review for residues by the 2000 JMPR. The Meeting received information on physical and chemical properties, metabolism and environmental fate, analytical methods, stability in frozen storage, registered uses, the results of supervised trials on fruits, vegetables, and field crops, and studies on processing.

Metabolism

Animals and birds

Parathion is metabolized to paraoxon and diethyl phosphorothioate. After oral administration of paraoxon to rats, diethyl phosphate, diethyl phosphorothioate, desethyl-paraoxon, and *para*-nitrophenol were identified in urine. In cattle, ruminal microorganisms are believed to be responsible for the production of aminoparathion and aminoparaoxon (Annex 6, reference 74).

When lactating goats, initially weighing 57 and 42 kg, were dosed with [^{14}C-phenyl]parathion at 188 mg/day (equivalent to 97 ppm in the diet) for 5 days, parathion was detected at 0.019 mg/kg in milk, 0.56 mg/kg in liver, 0.48 mg/kg in kidney, 0.15 mg/kg in renal fat, and 0.019 mg/kg in muscle. The major component of the residue was *para*-acetamido-paraoxon. Paraoxon itself was not detected. Approximately 40% of the administered radiolabel was recovered, leaving a large part unaccounted for.

When laying hens weighing 1.3–2.1 kg were dosed orally with [^{14}C-phenyl]parathion six times at daily intervals at a dose of 1.5 mg/day, equivalent to 16.5 ppm in the diet, parathion was detected at 0.001 mg/kg in eggs, 0.001 mg/kg in liver, 0.004 mg/kg in kidney, and 0.002 mg/kg in skin with fat. The total amounts of radiolabel in muscle were very low (< 0.01 mg/kg). Paraoxon was detected at 0.001 mg/kg in liver and kidney. The major identified components of the residue were *para*-nitrophenyl phosphate and *para*-acetamidophenol. The proportion of radiolabel accounted for in this study was 83%.

The studies showed that parathion is degraded by de-ethylation, oxidation, hydrolysis of the phosphate ester, reduction of the nitro group to an amine, and conjugation.

Plants

The Meeting received information on the fate of parathion in *wheat, cotton, and potatoes.*

The main component (51–65% of the radiolabel) of the residue in wheat straw, chaff, and grain sampled from wheat plants 7 days after a second treatment with [^{14}C-phenyl]parathion at 1.3 kg ai /ha was parathion itself. The concentrations found were: parathion, 66 mg/kg, and paraoxon, 4.2 mg/kg in straw; parathion, 197 mg/kg, paraoxon, 12 mg/kg in chaff; and parathion, 6.7 mg/kg, paraoxon, 0.13 mg/kg in grain. Other metabolites included *para*-nitrophenol, *S*-phenyl parathion, and *O*-desethyl parathion.

The concentration of parathion (0.019 mg/kg) in cottonseed was too low for identification 14 days after the plants were treated twice with [^{14}C-phenyl]parathion at 1.7 kg ai/ha. Parathion was the major residue component in calyx and leaf, but paraoxon, *para*-nitrophenol and other metabolites were also identified.

When potato plants were given two foliar treatments with [^{14}C-phenyl]parathion at 3.0 kg ai/ha and harvested 15 days after the second treatment, most of the radiolabel (20–31 mg/kg) remained in the stems and foliage, although small amounts (0.093–0.14 mg/kg) reached the tubers. Approximately 1% of the radiolabel in the tubers was identified by thin-layer chromatography as parathion and 10% as *para*-nitrophenol.

The plant metabolites identified indicate that hydrolysis of parathion to nitrophenol is the major pathway, but oxidation to paraoxon, some rearrangements of the thiophosphate ester, and *O*-de-ethylation also occur. Nitrophenol readily forms conjugates.

Environmental fate

Degradation in soil

Parathion was the major component of the residue in a 1-year study of metabolism in aerobic soil. The half-time for disappearance of the parent parathion was 58 days. After 1 month and 1 year, 9.8% and 44%, respectively, of the dose had mineralized. Paraoxon, nitrophenol, and *O,O*-bis(4-nitrophenyl)ethyl phosphate were identified as metabolites.

In a study of the metabolism of [^{14}C-phenyl]parathion in anaerobic soil under flooded conditions, the initial half-time for loss of parent parathion was 13 h, but the rate declined after 24 h, suggesting that some of the parathion became bound or was less readily available for microbial attack. Much of the dose (89% after 3 months) was converted to an unextractable residue. A considerable portion of the unextractable residues was incorporated into the biomass of the soil.

Fate in water and sediment systems

Parathion disappeared quickly, with an initial half-time of 2.4 days, during aerobic metabolism in a water–sediment system. After 1 month, parent parathion accounted for 2.5% of the dose, while 60% was unextractable. Very little (3%) had mineralized.

Methods of analysis

The Meeting received information on analytical methods for residues of parathion and paraoxon in supervised trials and for enforcement.

The analytical method used in supervised trials in the USA, most of which were carried out in 1988–90, were based on gas–liquid chromatography with flame photometry after solvent extraction and simple clean-up with solvent partition. A 30-min acid reflux was introduced at the extraction step because the studies of metabolism in wheat straw and grain had shown that the acid releases additional parathion and paraoxon residues. However, reflux acid extraction and extraction at room temperature with water and methanol of peppers and celery gave comparable results. The LOQ of the method was generally 0.05 mg/kg, and the analytical recovery was 80–90%. The method was tested and used on 39 substrates, including vegetables, nuts, forage, hay, olives, processed commodities, and wheat, and was tested for interference from 230 pesticides.

The method was modified by use of capillary gas–liquid chromatography to achieve an LOQ of 0.02 mg/kg for parathion and paraoxon in wheat, forage, and processed commodities. The recovery was generally 80–110%, that of paraoxon applied at 0.02 mg/kg tending to be higher. The method was tested on sorghum, rape-seed, and their processed commodities, with an LOQ of 0.02 mg/kg for some commodities and 0.05 mg/kg for others. The recovery after application at 0.02 mg/kg was unacceptably high for some commodities.

An LOQ of 0.01 mg/kg was achieved for parathion and paraoxon in apples and grapes in a method based on gas–liquid chromatography with flame photometry after acetone–water extraction, solvent partition, and C_{18} column clean-up.

A method for analysis of residues in animal commodities is based on capillary gas–liquid chromatography with flame photometry after acetone extraction of the sample and clean-up by solvent partition and on carbon Celite and C_{18} columns. The LOQ for parathion and paraoxon in liver and fat was 0.05 mg/kg. The concentration of parathion residues was similar after analysis of hen fat by this method (0.12 mg/kg) and by the ^{14}C method (0.14 mg/kg). LOQs of 0.001 mg/kg and 0.01 mg/kg were achieved for milk and kidney, respectively, in a similar method.

Stability of residues in stored samples

Parathion residues were stable in frozen storage for 2 years in almond kernels, apples, clover, cottonseed, green peppers, kidney beans, oranges, plums, snap beans, spinach, strawberries, and sunflower seeds; for 14 months in rape-seed, crude rape-seed oil, and rape-seed meal; for 19 months in sorghum flour; and for 4 months in maize grain, flour, starch, oil, meal, and corn grits. Because of the reproducibility of the analytical method, a decrease of less than 30% would not be distinguishable from variability. The concentrations of parathion residues in almond kernels and oranges appeared to have decreased by an estimated 30% within 2 years. Paraoxon residues were also stable in frozen storage, except in snap beans (in which a substantial decline was seen after 12 months), spinach (borderline 30% decrease), and rape-seed.

Definition of the residue

Parathion and paraoxon are the predominant components of the residue. Parathion represents the major portion of the residue, whereas paraoxon is a minor component when the residues are fresh and occur at higher concentrations. At very low concentrations in some circumstances, paraoxon may constitute a significant part of the residue. In residue trials that complied with GAP, 227 samples of food and feed commodities contained both parathion and paraoxon at concentrations that exceeded the LOQ. There was generally good agreement between the concentration of combined residues and that of parathion.

The Meeting recommended that the residue definition for compliance with MRLs continue to be parathion, and the definition for estimating dietary intake should be the sum of parathion and paraoxon expressed as parathion (parathion + 1.058 ∞ paraoxon).

The log P_{ow} of 3.2 and the results of studies of animal metabolism suggest that parathion is of borderline solubility in fat. In goats, the concentration of parathion residues in renal fat (0.15 mg/kg) was substantially higher than that in muscle tissue (0.019 mg/kg), although those in liver (0.56 mg/kg) and kidney (0.48 mg/kg) were both higher than that in fat. Paraoxon was not detected in the tissues or milk of the goat, but it was present at very low concentrations in liver and kidney of laying hens. The Meeting agreed that the residue definition for animal commodities should be reconsidered when the MRLs for animal commodities are recommended.

Results of supervised trials

Extensive data were provided from supervised trials on many crops: grapefruit, lemon, orange, apple, pear, apricot, cherry, plum and prune, blackberry, grape, strawberry, olive, garlic, onion, broccoli, cabbage, pepper, sweet corn, tomato, field pea, kale, lettuce, spinach, snap bean, dry bean, soya bean, carrot, potato, radish, sugar beet, turnip, celery, almond, pecan, walnut, barley, maize, rice, sorghum, wheat, rape-seed, cottonseed, and sunflower seed. Supervised trials based on unvalidated analytical data (from Craven Laboratories) could not be considered further for the following crops: alfalfa, broccoli, cabbage, carrot, garlic, kale, olive, processed olive, onion, pecan, potato, radish, sugar beet, tomato, turnip, walnut, and wheat.

No relevant GAP was available to evaluate data for: grapefruit, lemon, orange, pear, apricot, cherry, plum and prune, blackberry, grape, strawberry, pepper, field pea, lettuce, spinach, snap bean, dry bean, celery, almond, rice, alfalfa, and clover.

The Meeting agreed to withdraw the current recommendations for: apricot (1 mg/kg), leek (0.05 mg/kg), lemon (0.5 mg/kg), mandarin (0.5 mg/kg), virgin olive oil (2 mg/kg), olive (0.5 mg/kg), sweet and sour orange (0.5 mg/kg), peach (1 mg/kg), and potato (0.05* mg/kg), as the MRLs are not supported by current GAP or in supervised trials evaluated against current GAP.

The residue definition for dietary intake requires the addition of parathion and paraoxon residues expressed as parathion. In this calculation, concentrations of residues of paraoxon that were < LOQ were assumed to be 0, except when the concentrations of both parathion and paraoxon residues were < LOQ. In the latter case, the total was taken to be < LOQ, which is a reasonable assumption because the concentration of paraoxon is usually much lower than that of parathion. For example:

Parathion	Paraoxon	Total residue (parathion + 1.058 x paraoxon)
3.20	0.34	3.56
0.42	< 0.05	0.42
< 0.05	< 0.05	< 0.05

Trials of *apple* in the USA were not evaluated because there was no matching GAP. In Italy, parathion is registered for use on pome fruits at a spray concentration of 0.02–0.04 kg ai/hl with a PHI of 20 days. Twelve trials conducted in France in 1994 at 0.036 kg ai/hl with a 21-day PHI were evaluated against the Italian GAP. The concentrations of parathion residues in rank order (median in italics) were: < 0.01, 0.01 (2 trials), 0.02 (2 trials), ***0.02***, ***0.03***, 0.05, 0.08 (2 trials), 0.14, and 0.16 mg/kg. As the values for paraoxon were all < LOQ (0.01 mg/kg), the concentration of total residue is the same as that for parathion.

The Meeting estimated a maximum residue level of 0.2 mg/kg, a STMR value of 0.025 mg/kg, and a HR value of 0.16 mg/kg for parathion in apples. The estimated maximum residue level replaces the current recommendation of 0.05* mg/kg.

Parathion is registered in the USA for use on *sweet corn* at a rate of 0.28–0.84 kg ai/ha with a PHI of 12 days. Ten trials in four states in 1987–89 involving six applications of 1.1 kg ai/ha and harvesting 12 days after the final treatment showed no residues of parathion or paraoxon in sweet corn ears that exceeded the LOQ (0.05 mg/kg). Although no residues were detected, there was no evidence that residues were not present, and the STMR value should be equivalent to the LOQ.

The Meeting estimated a maximum residue level of 0.05* mg/kg, a STMR value of 0.05 mg/kg, and a HR value of 0.05 mg/kg for parathion in sweet corn.

Parathion is registered in the USA for use on *soya bean* at 0.28–0.84 kg ai/ha with a PHI of 20 days for harvesting, cutting, or use as forage. Eight trials in three states in 1988 with two applications of 0.90 kg ai/ha (PHI, 20 days) showed no residue (< 0.05 mg/kg) of parathion or paraoxon in harvested soya beans. Although no residues were detected, there was no evidence that residues were not present, and the STMR value should be equivalent to the LOQ.

The Meeting estimated a maximum residue level of 0.05* mg/kg, a STMR value of 0.05 mg/kg, and a HR value of 0.05 mg/kg for parathion in dry soya beans. The estimated maximum residue level confirms the current recommendation for dry soya beans of 0.05* mg/kg.

Parathion is registered in the USA for use on *barley* at 0.28–0.84 kg ai/ha with a PHI of 15 days for harvesting, cutting, or use as forage. Twelve trials in eight states in 1997 and 1998 with six aerial applications of 0.81–0.84 kg ai/ha and harvesting 14 or 15 days after the final treatment resulted in the following concentrations of parathion residues in barley grain: 0.15, 0.25, 0.54, 0.78, 1.3, 1.6, 2.0, 2.2 (2 trials), 3.3, 4.1, and 4.9 mg/kg, and those of the combined residues of parathion and paraoxon in rank order were: 0.16, 0.27, 0.61, 0.81, 1.4, ***1.7***, ***2.2***, 2.3, 2.3, 3.6, 4.4, and 5.1 mg/kg.

The Meeting estimated a maximum residue level of 7 mg/kg, a STMR value of 1.95 mg/kg, and a HR value of 5.1 mg/kg for parathion in barley.

Parathion is registered in the USA for use on *maize* at 0.28–0.84 kg ai/ha with a PHI of 12 days for harvesting, cutting, or use as forage. Twelve trials in six states in 1987–89 with five or six applications of 1.1 kg ai/ha and harvesting 12 days after the final treatment resulted in the following concentrations of parathion residues in maize grain: < 0.05 (10 trials), 0.06, and 0.09 mg/kg. The concentrations of paraoxon residues were all < LOQ (0.05 mg/kg).

The Meeting estimated a maximum residue level of 0.1 mg/kg, a STMR value of 0.05 mg/kg, and a HR value of 0.09 mg/kg for parathion in maize. The estimated maximum residue level confirms the current recommendation for maize of 0.1 mg/kg.

Parathion is registered in the USA for use on *sorghum* at 0.28–1.1 kg ai/ha with a PHI of 12 days for harvesting, cutting, or use as forage. Six trials in 1987, five in 1992, and two in 1994 in six states with two or six applications of 1.1 kg ai/ha and harvesting 12 days after the final treatment resulted in the following concentrations of parathion residues in sorghum grain: 0.29, 0.54, 0.61, 0.69, 0.71, 0.79, 0.85, 1.3, 1.6, 1.7, 2.0, 3.3, and 3.8 mg/kg, and concentrations of combined parathion and paraoxon residues in rank order of: 0.29, 0.55, 0.74, 0.75, 0.76, 1.03, ***1.06***, 1.4, 1.8, 1.9, 2.1, 3.5, and 4.2 mg/kg.

The Meeting estimated a maximum residue level of 5 mg/kg, a STMR value of 1.06 mg/kg, and a HR value of 4.2 mg/kg for parathion in sorghum. The estimated maximum residue level confirms the current recommendation for sorghum of 5 mg/kg.

Parathion is registered in the USA for use on *wheat* at 0.28–0.84 kg ai/ha with a PHI of 15 days for harvesting, cutting, or use as forage. Seven trials in 1992, five in 1993, and four in 1994 in 11 states, with two aerial applications of 0.69–0.93 kg ai/ha (most trials at 0.84 kg ai/ha) and harvesting 15 days (or longer if the residue concentration was higher than at 15 days) after the final treatment resulted in the following concentrations of parathion residues in wheat grain: 0.02, 0.05 (2 trials), 0.06 (2 trials), 0.07, 0.08, 0.11, 0.12 (2 trials), 0.14, 0.16, 0.21, 0.54, 0.63, and 0.92 mg/kg, and those of combined parathion and paraoxon residues in rank order were: 0.02, 0.05 (2 trials), 0.06, 0.07, 0.08 (2 trials), ***0.11***, ***0.14***, 0.15, 0.16 (2 trials), 0.21, 0.54, 0.65, and 0.96 mg/kg.

The Meeting estimated a maximum residue level of 1 mg/kg, a STMR value of 0.125 mg/kg, and a HR value of 0.96 mg/kg for parathion in wheat.

Parathion is registered in the USA for use on *oilseed rape* at 0.56 kg ai/ha with a PHI of 28 days. Five trials in five states in 1992 and 1994, with two aerial applications of 0.56 kg ai/ha (0.50 kg ai/ha in one trial) and harvesting 28 days after the final treatment resulted in the following concentrations of parathion residues in rape-seed: < 0.05 (2 trials), 0.09, 0.12, and 0.13 mg/kg. The concentrations of paraoxon residues were < LOQ (0.05 mg/kg) in all trials.

The Meeting decided that five trials were too few to allow recommendation of a maximum residue level.

Parathion is registered in the USA for use on *cotton* at 0.29–1.1 kg ai/ha with a PHI of 7 days. Six trials on cottonseed in 1987 and 12 in 1997 in six states, with six applications of 1.1 kg ai/ha (1.4 kg ai/ha in three trials, still considered to comply with GAP) and harvesting 7 days after the final treatment resulted in the following concentrations of parathion residues: 0.13, 0.15 (2 trials), 0.19, 0.20 (2 trials), 0.21, 0.26, 0.30, 0.33, 0.40, 0.48, 0.65, 0.66, 0.97, 1.1, 1.3, and 2.0 mg/kg, and those of the combined parathion and paraoxon residues in rank order were: 0.13, 0.15 (2 trials), 0.19, 0.21 (3 trials), 0.26, ***0.31***, ***0.39***, 0.44, 0.48, 0.67, 0.75, 1.1, 1.2, 1.4, and 2.1 mg/kg.

The Meeting estimated a maximum residue level of 3 mg/kg, a STMR value of 0.35 mg/kg, and a HR value of 2.1 mg/kg for parathion in cottonseed. The estimated maximum residue level replaces the current recommendation (1 mg/kg) for cottonseed.

Parathion is registered in the USA for use on *sunflower* at 0.56–1.1 kg ai/ha with a PHI of 30 days. Seven trials in 1988 and 1999 in two states, with three applications of 1.1 kg ai/ha and harvesting 30 days after the final treatment resulted in no residues of parathion or paraoxon > LOQ (0.05 mg/kg). Residues of both compounds were detected in sunflower seed in a processing study after treatment at five times the labelled rate, however, indicating that, even though no residues were found at > LOQ in the supervised trials, the concentration is not effectively 0. The STMR value should therefore be equivalent to the LOQ.

The Meeting estimated a maximum residue level of 0.05* mg/kg, a STMR value of 0.05 mg/kg, and a HR value of 0.05 mg/kg for parathion in sunflower seed. The estimated maximum residue level confirms the current recommendation for sunflower seed of 0.05* mg/kg.

As noted above, parathion is registered in the USA for use on barley. Twelve trials in eight states in 1997 and 1998, with six aerial applications of 0.78–0.84 kg ai/ha and cutting or harvesting 14–16 days after the final treatment resulted in residues in *barley hay and straw.* As the moisture was

measured, the residues could be expressed on a dry weight basis. The concentrations of parathion residues in barley hay were: 0.10 (2 trials), 0.16, 0.18, 0.19, 0.21, 0.55, 0.70, 0.73, 1.1, 3.6, and 4.7 mg/kg (fresh weight) and 0.14, 0.15, 0.25, 0.26 (2 trials), 0.28, 0.80, 1.0, 1.1, 1.6, 5.9, and 6.5 mg/kg (dry weight). The concentrations of combined parathion and paraoxon residues in barley hay were: 0.17, 0.18, 0.29, 0.34 (2 trials), ***0.37***, ***0.86***, 1.2, 1.7, 1.8, 6.2, and 8.1 mg/kg (dry weight). The concentrations of parathion residues in barley straw were: 0.6, 0.7, 1.3, 2.0, 2.8, 2.9, 3.5 (2 trials), 7.6, 8.0, 9.6, and 13 mg/kg (fresh weight) and 1.0, 1.3, 2.6, 3.2, 5.1, 6.1, 6.4, 7.1, 12, 14, 16, and 20 mg/kg (dry weight). The concentrations of combined parathion and paraoxon residues in barley straw were: 1.4, 1.6, 3.1, 4.7, 6.2, ***7.3***, ***8.2***, 8.8, 14, 16, 20, and 24 mg/kg (dry weight).

The data for barley hay and straw were combined to establish a MRL for barley straw and fodder. The concentrations of residues in straw were usually higher than those in hay in the same trial (both expressed as dry weight). The higher value (for hay or straw on a dry weight basis) in each trial was taken to represent that for the residue in barley straw and fodder in that trial. The concentrations of parathion residues in barley straw and fodder were thus: 1.0, 1.3, 3.2, 5.1, 5.9, 6.1, 6.4, 7.1, 12, 14, 16, and 20 mg/kg (dry weight), and those of the combined residues of parathion and paraoxon were: 1.4, 1.6, 4.7, 6.2 (2 trials), ***7.3***, ***8.2***, 8.8, 14, 16, 20, and 24 mg/kg (dry weight).

The Meeting estimated a maximum residue level of 30 mg/kg and a STMR value of 7.75 mg/kg for parathion in barley straw and fodder (dry weight).

As noted above, parathion is registered in the USA for use on maize. A series of 27 trials in eight states in 1987–89, with six applications of 1.1 kg ai/ha and harvesting or cutting 12 days after the final treatment resulted in residues in *maize fodder, forage, and silage.* The application rate of 1.1 kg ai/ha used in the trials is 33% higher than the recommended rate (1 pint per acre [1.4 l/ha] in trials, 0.75 pint per acre [1.3 l/ha] according to GAP), but the data were considered adequate to represent residues resulting from GAP. Data were not available on moisture levels or percent dry matter.

The concentrations of the resulting parathion residues in *maize fodder* were: < 0.05, 0.06, 0.10, 0.12, 0.39, 0.45, 0.74, 0.86, 0.92, 1.4, 1.6, 2.3, 2.6, 2.7, 5.5, 6.3, 8.0, 8.4, 13, and 19 mg/kg (fresh weight), and those of the combined parathion and paraoxon residues were: < 0.05, 0.12, 0.17, 0.25, 0.51, 0.58, 0.80, 0.86, 0.98, ***1.6***, ***2.0***, 2.4, 2.8, 3.0, 5.9, 6.8, 9.3, 9.1, 14, and 22 mg/kg (fresh weight). Allowing for the standard 83% of dry matter in maize fodder (FAO, 1997, p. 123, corn stover = maize fodder), the Meeting estimated a maximum residue level of 30 mg/kg and a STMR value of 2.13 mg/kg for parathion in maize fodder (dry weight). The highest value of dry weight = 22/0.83 = 26.5.

The concentrations of parathion residues in *maize forage* were: < 0.05, 0.05, 0.09, 0.10, 0.56, 1.1, 1.3, 1.4, 1.5, and 2.1 mg/kg (fresh weight), and those of the combined parathion and paraoxon residues were: < 0.05, 0.12, 0.15, 0.16, ***0.73***, ***1.1***, 1.5 (2 trials), 1.6, and 2.3 mg/kg (fresh weight). Allowing for the standard 40% of dry matter in maize forage (FAO, 1997, p. 123), the Meeting estimated a maximum residue level of 10 mg/kg and a STMR value of 2.28 mg/kg for parathion in maize forage (dry weight). The highest value of dry weight = 2.3/0.40 = 5.75 and the STMR dry weight = 0.5 ∞ (0.73 + 1.1)/0.40 = 2.28.

The concentrations of parathion residues in *maize silage* were: 0.34, 0.78, 1.1, 1.2, 1.3, 1.8, 2.4, and 2.6 mg/kg (fresh weight). No information on the percent dry matter in the silage was available, but the residues in silage should be covered by the estimated MRL for fodder.

As noted above, parathion is registered in the USA for use on sorghum. Eight trials in six states in 1992 and 1994, with two aerial applications of 1.1 kg ai/ha and harvesting or cutting 12 days after the second application resulted in residues in *sorghum forage, fodder, and hay.* The percent dry matter was available for all samples.

The resulting concentrations of residues of parathion in *sorghum fodder and hay* were: 0.18, 0.25, 0.34, 0.52, 0.87, 1.6, 1.2, and 4.3 mg/kg (fresh weight) or 0.38, 0.78, 1.4, 2.4, 3.0, 3.9, 4.3, and 10 mg/kg (dry weight), and those of the combined parathion and paraoxon residues were: 0.18, 0.25, 0.34, ***0.52***, ***0.92***, 1.6, 1.3, and 4.3 mg/kg (fresh weight) or 0.38, 0.78, 1.4, ***2.4***, ***3.2***, 3.9, 4.7, and 10 mg/kg (dry weight). The Meeting estimated a maximum residue level of 15 mg/kg and a STMR value of 2.8 mg/kg for parathion in sorghum straw and fodder (dry weight).

The concentrations of residues of parathion in *sorghum forage* were: 0.09, 0.34, 0.40, ***0.56***, 0.72, 1.1, and 1.7 mg/kg (fresh weight) or 0.35, 1.1, 2.7, ***3.1***, 3.5, 3.8 and 8.5 mg/kg (dry weight). The concentration of paraoxon residues did not exceed the LOQ (0.05 mg/kg) in any sample. The Meeting estimated a maximum residue level of 10 mg/kg and a STMR value of 3.1 mg/kg for parathion in sorghum forage (dry weight).

As noted above, parathion is registered in the USA for use on wheat. Trials in 10 states in 1992–94, with two aerial applications of 0.84 kg ai/ha and harvesting or cutting 15 days after the second application resulted in residues in *wheat forage and straw*. The percent dry matter was available for all samples in some trials and for representative samples in others.

The concentrations of residues of parathion in *wheat forage* were: < 0.05, 0.09 (2 trials), 0.10, 0.12, 0.15, 0.48, 0.52, and 0.79 mg/kg (fresh weight) or < 0.05, 0.30, 0.33, 0.40, 0.46, 0.47, 1.9, 2.2, and 3.2 mg/kg (dry weight), and those of the combined parathion and paraoxon residues were: < 0.05, 0.09, 0.10, 0.11, ***0.12***, 0.21, 0.62, 0.66, and 0.89 mg/kg (fresh weight) or < 0.05, 0.30, 0.33, 0.40, ***0.57***, 0.64, 2.4, 2.8, and 3.5 mg/kg (dry weight). Residues in wheat forage are covered by the recommendations for wheat straw and fodder.

The concentrations of residues of parathion in *wheat straw* were: 0.50, 0.67, 0.98, 1.0, 1.2, 1.4, 1.5, 1.8 (2 trials), 1.9, 3.1 (2 trials), 3.5, 3.8, 7.3, 7.5, and 9.5 mg/kg (fresh weight) or 0.70, 0.91, 1.2, 1.5 (2 trials), 2.9, 3.2, 3.3, 3.4 (2 trials), 4.2 (3 trials), 5.0, 8.2, 11, and 18 mg/kg (dry weight). The concentrations of the combined parathion and paraoxon residues were: 0.65, 0.67, 1.0, 1.3 (2 trials), 1.6, 1.7, ***2.0*** (2 trials), 2.1, 3.3, 3.4, 3.7, 4.3, 7.8, 8.1, and 10 mg/kg (fresh weight) or 0.91 (2 trials), 1.5, 1.6, 1.9, 3.1, 3.5, 3.6, ***3.7*** (2 trials), 4.4, 4.5, 4.8, 5.2, 8.9, 12, and 19 mg/kg (dry weight). The Meeting estimated a maximum residue level of 20 mg/kg and a STMR value of 3.7 mg/kg for parathion in wheat straw and fodder (dry weight).

As noted above, parathion is registered in the USA for use on soya beans. Eight trials in three states in 1988, with two aerial applications of 0.90 kg ai/ha and a PHI of 20 days resulted in the following concentrations of parathion residues in *soya bean hay*: 0.13, 0.25, 0.32, 0.46, 0.50, 0.57, 0.61, and 0.62 mg/kg (fresh weight), and those of the combined parathion and paraoxon residues were: 0.13, 0.25, 0.43, ***0.46***, ***0.61***, 0.62, 0.68, and 0.81 mg/kg (fresh weight). Allowing for the standard 85% of dry matter in soya bean hay (FAO, 1997, p. 126), the Meeting estimated a maximum residue level of 2 mg/kg and a STMR value of 0.63 mg/kg for parathion in soya bean fodder (dry weight).

Fate of residues during processing

The Meeting received information on the fate of incurred residues of parathion and paraoxon during the processing of lemons, grapefruit, oranges, apples, grapes, oats, maize, rice, sorghum, wheat, sunflower seed, cottonseed, and rape-seed, and processing factors were calculated for processed commodities derived from these raw agricultural commodities. The studies on apples, cottonseed, maize, sorghum, sunflower seed, and wheat are summarized below because maximum residue levels are estimated for these raw agricultural commodities.

Processing factors were calculated for parathion residues and for combined parathion and paraoxon residues. As parathion is the dominant component of the residue, the processing factor is similar with the two calculations. Nevertheless, since these factors are used in calculating the concentrations of residues in processed foods for the purpose of estimating dietary intake, that for the combined residue was used when available. When the concentration of residues in the processed commodity did not exceed the LOQ, the processing factor was calculated from the LOQ and was prefixed with a 'less than' symbol (<).

The factors for estimating parathion after the processing of *apples* to dry pomace were divergent, 3.1 and 0.16, reflecting the results of two processes. The Meeting decided to use the conservative value of 3.1 rather than the mean, which would represent neither process. Residues were detected in apple juice with one process but not the other, leading to processing factors of < 0.018 and 0.072, and the conservative value 0.072 was chosen. Application of these factors to the STMR value and MRL for apples provides a STMR-P value of 0.078 mg/kg and a HR-P value of 0.62 mg/kg for dry apple pomace and a STMR value for apple juice of 0.0018 mg/kg.

The processing factors for dry milling of *maize* were: grits (< 0.36, 0.99; best estimate, 0.99), meal (0.69, 0.88; mean, 0.74), flour (0.47, 0.88; mean, 0.68), crude oil (0.47, 0.66; mean, 0.57), and refined oil (0.80, 2.0; mean, 1.4). The processing factors for wet milling of maize were: starch (< 0.36, < 0.28; best estimate, < 0.28), crude oil (1.3, 3.4; mean, 2.3), and refined oil (1.3, 3.5; mean, 2.4). Application of the factors to the STMR value and MRL for maize provides a STMR-P value of 0.037 mg/kg and a HR-P value of 0.074 mg/kg for maize meal and STMR-P values of 0.05 mg/kg for grits, 0.034 mg/kg for maize flour, and 0.014 mg/kg for maize starch. Application of the factor for maize flour (0.68) to the MRL for maize results in a calculated HR value of 0.068 mg/kg in maize flour. The Meeting estimated a maximum residue level of 0.1 mg/kg for parathion in maize flour.

The two processes resulted in different concentrations of residues in maize oil. The processing factors for oils were 0.57 and 1.4 with the dry process and 2.3 and 2.4 with the wet process. The Meeting agreed to use the values for the wet process, which, when applied to the STMR value for maize, provide STMR-P values of 0.12 mg/kg for both crude oil and refined oil. Application of the processing factors to the MRL for maize results in calculated HR levels of 0.23 and 0.24 mg/kg in crude and refined oils, respectively. The Meeting estimated a maximum residue level of 0.3 mg/kg for parathion in both crude and refined maize oil.

The processing factors for parathion after milling of *sorghum* were: 1.6, 3.7, 1.16, and 1.01 (mean, 1.9) for bran; 0.34 and 0.57 (mean, 0.46) for grits; 0.23 and 0.57 (mean, 0.40) for flour; and 0.012 and 0.018 (mean, 0.015) for starch. Application of the factors to the STMR value for sorghum provides STMR-P values of 2.0 mg/kg for bran, 0.49 mg/kg for grits, 0.42 mg/kg for flour, and 0.016 mg/kg for starch.

The processing factors for parathion after milling of *wheat* were: 4.6 for bran, 0.80 for shorts, and 0.35 for flour. Application of the factors to the STMR value and MRL for wheat provides STMR-P and HR-P values of 0.10 and 0.80 mg/kg for wheat shorts and STMR-P values of 0.044 mg/kg for wheat flour and 0.58 mg/kg for wheat bran. Only one milling trial was available for wheat, a major commodity, and this was considered insufficient to allow recommendation of maximum residue levels for wheat bran and flour.

The processing factors for *sunflower seed* were: 0.072 for meal and 0.42 for refined sunflower seed oil. Application of the factors to the STMR value and MRL for sunflower seed provides STMR-P and HR-P values for sunflower seed meal of 0.0025 mg/kg and a STMR-P value for refined sunflower seed oil of 0.021 mg/kg. The Meeting noted that parathion and paraoxon residues in refined oil were

depleted below the concentrations in the seed and estimated a maximum residue level of 0.05* mg/kg for edible sunflower seed oil, on the basis of the LOQ of the method in trials on sunflower seeds.

The processing studies on *cottonseed* could not be used because no data on residues were provided.

Residues in animal and poultry commodities

The Meeting estimated the dietary burden of parathion residues in farm animals on the basis of the diets listed in Appendix IX of the *FAO Manual* (FAO, 1997). Calculation from MRLs (or HR values) provides concentrations in feed suitable for estimating MRLs for animal commodities, while calculation from STMR values for feed is suitable for estimating STMR values for animal commodities. The percent dry matter is considered to be 100% for MRLs and STMR values expressed in dry weight.

Commodity	MRL or HR	Group	% dry matter	MRL/dry matter	Percent of diet			Concentration of residue (mg/kg)		
					Beef cattle	Dairy cows	Poultry	Beef cattle	Dairy cows	Poultry
Maize forage	10	AF	100	10	15			1.50		
Sorghum forage	10	AF	100	10						
Barley straw and fodder, dry	30	AS	100	30	25	60		7.50	18.00	
Maize fodder	30	AS	100	30						
Sorghum straw and fodder, dry	15	AS	100	15						
Wheat straw and fodder, dry	20	AS	100	30						
Soya bean fodder	2	AL	100	2	10			0.20		
Maize meal	0.074	CF	85	0.087						
Wheat shorts	0.80	CM	88	0.91						
Barley	7	GC	88	8.0	50	40	75	3.98	3.18	5.97
Maize	0.1	GC	88	0.11						
Sorghum	5	GC	86	5.81			5			0.29
Wheat	1	GC	89	1.12						
Apple pomace, dry	0.62	AB	100	0.62						
Sunflower seed meal	0.0025		92	0.003			20			0.00
Total								13.2	21.2	6.26

Commodity	STMR	Group	% dry matter	STMR/dry matter	Percent of diet			Concentration of residue (mg/kg)		
					Beef cattle	Dairy cows	Poultry	Beef cattle	Dairy cows	Poultry
Maize forage	2.28	AF	100	2.28						
Sorghum forage	3.1	AF	100	3.10	15			0.47		
Barley straw and fodder, dry	7.75	AS	100	7.75	25	60		1.94	4.65	
Maize fodder	2.13	AS	100	2.13						
Sorghum straw and fodder, dry	2.8	AS	100	2.80						
Wheat straw and fodder, dry	3.7	AS	100	3.70						
Soya bean fodder	0.63	AL	100	0.63	10			0.06		

Maize meal	0.037	CF	85	0.044						
Wheat shorts	0.10	CM	88	0.11						
Barley	1.95	GC	88	2.22	50	40	75	1.11	0.89	1.66
Maize	0.05	GC	88	0.06						
Sorghum	1.06	GC	86	1.23			5			0.06
Wheat	0.125	GC	89	0.14						
Apple pomace, dry	0.078	AB	100	0.078						
Sunflower seed meal	0.0025		92	0.003			20			0.00
Total								3.6	5.5	1.72

The dietary burdens of parathion for estimating MRLs and STMR values (concentrations of residue in animal feeds expressed in dry weight) are: 13 and 3.6 ppm in beef cattle, 21 and 5.5 ppm in dairy cows, and 6.3 and 1.7 ppm in poultry. The studies of metabolism in goats fed diets containing 97 ppm and laying hens fed diets containing 16.5 ppm provide evidence that the concentration of parathion is likely to be low in meat, milk, and eggs. However, the duration of feeding in these studies was only 5 or 6 days, only one dietary concentration was tested making interpolation or extrapolation to other concentrations difficult, and the concentration in eggs may not have reached a plateau by the end of the study.

The Meeting decided that studies of farm animal feeding were needed for estimation of MRLs and STMR values for animal and poultry commodities. The Meeting was informed that a study in dairy cows and one in laying hens were available.

Further work or information

Desirable

- An additional trial on milling of wheat for estimation of maximum residue levels in flour and bran
- Information on the fate of parathion during malting and brewing of barley
- Studies of farm animal feeding to permit estimation of maximum residue levels and STMR values for animal commodities. . The Meeting was informed that studies in dairy cows and laying hens were available.

Dietary risk assessment

Chronic intake

The periodic review of parathion resulted in recommendations for new and revised MRLs and new STMR values for raw and processed commodities. Data on consumption were available for 10 food commodities and were used in calculating dietary intake. The results are shown in Annex 3.

The international estimated daily intakes from the five GEMS/Food regional diets, based on estimated STMR values, represented 7–20% of the ADI. The Meeting concluded that long-term intake of residues of parathion from uses that have been considered by the JMPR is unlikely to present a public health concern.

Short-term intake

The IESTI of parathion was calculated for the food commodities (and their processing fractions) for which maximum residue levels and STMR values have been estimated and for which data on consumption were available. The results are shown in Annex 4. The IESTI represented 0–400% of the acute RfD for the general population. That representing 400% results from a direct calculation based on the residues in barley because no data were available on the fate of parathion

during brewing. The IESTI represented 0–140% of the acute RfD for children. The value of 140% represents the estimated short-term intake of residues in apples, but the Meeting was informed that the large portion size (679 g) of apple consumption by children may represent total apple consumption (including apple juice) rather than consumption of whole apples only.

The Meeting concluded that the acute intake of residues of parathion from uses, other than on barley and apples, that have been considered by the JMPR is unlikely to present a public health concern.

4.18 Parathion-methyl (059)

Residue and analytical aspects

Parathion-methyl was first evaluated by the Joint Meeting in 1965 and has been reviewed several times since. At its thirtieth session in 1998, the CCPR (ALINORM 99/24, Appendix VII) listed parathion for periodic review for residues by the 2000 JMPR. The Meeting received information on physical and chemical properties, metabolism and environmental fate, analytical methods, stability in frozen storage, registered uses, the results of supervised trials on fruits, vegetables, and field crops, and studies on processing.

Metabolism

Animals and birds

When a lactating goat weighing 60 kg was given [^{14}C-phenyl]parathion-methyl orally at a dose of 35 mg per day (equivalent to 6.25 ppm in the diet) daily for 3 days, no residues of parathion-methyl or paraoxon-methyl were detected in tissues or milk. However, as only 35.5% of the administered radiolabel was recovered, a large proportion was unaccounted for.

When laying hens were given [^{14}C-phenyl]parathion-methyl orally three times at daily intervals at a dose of 0.5 mg/kg bw (equivalent to 6.25 ppm in the diet), the compound was detected in tissues but not in eggs, while paraoxon-methyl was detected in neither tissues nor eggs. The highest concentrations of parathion-methyl were found in skin and fat, suggesting a certain degree of solubility in fat. Only 54% of the radiolabel was accounted for.

The metabolites identified indicate that parathion-methyl is degraded by demethylation, oxidation, hydrolysis of the phosphate ester, reduction of the nitro group to an amine, and conjugation.

Plants

The Meeting received information on the fate of parathion-methyl in potatoes, cotton, and lettuce. Only 0.01–0.02% of the radiolabel in *potato* plants was found in the tubers 5 days after application of [^{14}C-phenyl]parathion-methyl as a foliar spray to the plants at a rate equivalent to 4.7 kg ai/ha. Parathion-methyl was identified in the tubers at a concentration of 0.001 mg/kg. In plants harvested 21 days after treatment, the tubers contained 0.13–0.14% of the radiolabel, and paraoxon-methyl was tentatively identified at a concentration of 0.002 mg/kg. Very low concentrations of nitrophenyl conjugates were also identified.

Parathion-methyl was found at a concentration of 0.008 mg/kg in *cottonseed* 10 days after foliar application of [^{14}C-phenyl]parathion-methyl to cotton plants at the equivalent of 0.38 kg ai/ha. Nitrophenol, *para*-nitrophenyl-glucopyranoside, and *O*-demethyl-parathion-methyl were also components of the residue.

Lettuce plants harvested 14 and 21 days after foliar treatment with [^{14}C-phenyl]parathion-methyl at a rate equivalent to 1.23 kg ai/ha contained parathion-methyl residues at a concentration of of 2.2 or 0.097 mg/kg, respectively. Neither paraoxon-methyl nor any other metabolite containing P–O was detected. The metabolites *para*-nitrophenol, *para*-nitrophenylglucopyranoside, and *O*-demethyl-parathion-methyl were identified. In a further experiment on lettuce, the major metabolite was 4-nitrophenyl 6-*O*-malonyl-β-D-glucopyranoside.

The plant metabolites identified indicate that hydrolysis of parathion-methyl to nitrophenol is the major metabolic pathway, but *O*-demethylation and oxidation to paraoxon-methyl may also occur to a limited extent. *para*-Nitrophenol is readily conjugated.

The Meeting noted that no information was available on the fate of parathion-methyl in fruit crops but was informed that studies were planned to support the re-registration programme in the European Union.

Environmental fate

Parathion-methyl residues disappeared quickly (initial half-time, 3.9 days) during incubation in aerobic soil. The metabolites identified were *para*-nitrophenol and *O*,*O*-bis(4-nitrophenyl)-*O*-methylphosphorothioate. Under anaerobic conditions, parathion-methyl disappeared rapidly, with an initial half-time of 10.5 h. Nitrophenol was a major component of the residue during the first week, but the concentration declined rapidly thereafter. Parathion-methyl had medium to low mobility on four soils in a laboratory study and did not appear below the top 10 cm in two field studies of soil dissipation. No residues of paraoxon-methyl were detected in any sample in the field studies.

Direct photodegradation of parathion-methyl residues in water is likely to make a minor contribution to its overall disappearance from the environment. In aquatic field studies (rice paddies), parathion-methyl disappeared quickly, and was detectable in the water only on the day of application or the next day.

Methods of analysis

The analytical methods for parathion-methyl and paraoxon-methyl are based on gas–liquid chromatography with flame photometry after solvent extraction and simple clean-up by solvent partition and reversed-phase column chromatography. Some variations are required for different substrates, particularly in the extraction step. A LOQ of 0.01 mg/kg is achieved for many substrates, but the validated LOQ for difficult substrates is 0.05 mg/kg.

The method used in many of the supervised trials in the USA included an initial 1-h reflux of the sample in acidic aqueous methanol before clean-up. The typical LOQ in trials conducted in the 1980s and early 1990s was 0.05 mg/kg, but 0.01 mg/kg was achieved in later trials.

Stability of residues in stored samples

Residues of parathion-methyl in bluegrass hay, rape-seed, celery, clover forage, dry bean seeds, dry pea seeds, dry pea straw, head cabbages, lettuce, maize fodder, maize forage, maize grain, mustard, onions, snap bean seeds and pods, soya bean seeds, succulent pea forage, succulent pea pods, sunflower seeds, turnip roots, turnip tops, wheat forage, wheat grain, and wheat straw, in processed crude rape-seed oil and rape-seed meal, and in soils were stable during frozen storage for the durations tested (mostly 2 years). Residues of paraoxon-methyl were also stable in frozen storage, with a few exceptions. The calculated times for a 30% decrease in the concentration of paraoxon-methyl residues

were: 5 months in rape-seed, 12 months in crude rape-seed oil, 7 months in rape-seed meal, and 13 months in lettuce.

No information was available on the stability of parathion-methyl or paraoxon-methyl residues in frozen storage of fruits. Because parathion-methyl has been tested in many commodities with consistent results, it is probably stable in fruit matrices; however, the stability of paraoxon-methyl residues in fruits is not established. The Meeting was informed that studies of the stability of fruits in frozen storage are being planned to support the re-registration programme of the European Union. The concentrations of paraoxon-methyl sample decreased by 30% within about 250 days in a frozen sample of sandy loam and 22 days in one of loam soil.

Definition of the residue

Parathion-methyl and paraoxon-methyl are the most important components for the residue definition. The contributions of residues of the two components to the total residue in food and feed commodities in GAP trials at the recommended PHIs were examined. In 54 trials of food commodities and 155 of feed commodities, the concentrations of both components exceeded the LOQ. The total concentration of residues was closely related to that of parathion-methyl in both food and feed commodities, but the relationship was less close at lower concentrations.

The Meeting recommended that the residue definition for compliance with MRLs continue to be parathion-methyl and that for estimation of dietary intake should be the sum of parathion-methyl and paraoxon-methyl expressed as parathion-methyl (parathion-methyl + 1.065 ∞ paraoxon-methyl). The residue definition applies to plant commodities and it should be reconsidered when MRLs for animal commodities are recommended.

Results of supervised trials

Extensive data were provided from supervised trials on many crops: apple, pear, peach, grape, onion, broccoli, cabbage, sweet corn, mustard green, lettuce, spinach, lima bean, snap bean, soya bean, field pea, dried bean, carrot, potato, sugar beet, turnip, celery, artichoke, maize, rice, sorghum, wheat, cottonseed, rape-seed, sunflower seed, alfalfa, clover, pasture grass, and hops. No relevant GAP was available to evaluate the data for: pear, onion, broccoli, sweet corn, mustard green, lettuce, spinach, lima bean, snap bean, soya bean, carrot, turnip, celery, artichoke, sorghum, sunflower seed, clover, or hops.

The Meeting agreed to withdraw the recommended MRLs for globe artichoke (2 mg/kg), broccoli (0.2 mg/kg), carrot (1 mg/kg), celery (5 mg/kg), cherry (0.01* mg/kg), clover (10 mg/kg), common bean (0.05* mg/kg), garden pea (1 mg/kg) gooseberry (0.01* mg/kg), dry hops (1 mg/kg), lettuce head (0.05* mg/kg), lettuce leaf (0.5 mg/kg), lima bean (0.05* mg/kg), mustard green (0.5 mg/kg), plum including prune (0.01* mg/kg), red and black raspberry (0.01* mg/kg), spinach (0.5 mg/kg), turnip green (2 mg/kg), and garden turnip (0.05* mg/kg). These MRLs were not supported by current GAP or by the results of supervised trials that matched current GAP.

The residue definition for dietary intake requires the addition of parathion-methyl and paraoxon-methyl residues expressed as parathion-methyl. In this calculation, concentrations of residues of paraoxon-methyl that were < LOQ were assumed to be 0, except when the concentrations of both parathion-methyl and paraoxon-methyl residues were < LOQ. For example:

Parathion-methyl	Paraoxon-methyl	Total residue (parathion-methyl + 1.058 x paraoxon-methyl)
3.20	0.34	3.56
0.42	< 0.05	0.42
< 0.05	< 0.05	< 0.05

The results of supervised trials on *apple* in Germany were not evaluated because there was no matching GAP. In France, parathion-methyl is registered for use on pome fruits at a spray concentration of 0.03 kg ai/hl with a PHI of 15 days. In 26 trials conducted in France in 1994 and 1995 at 0.036 kg ai/hl and a 14-day PHI, the concentrations of parathion-methyl residues, in rank order, were: < 0.01 (3 trials), 0.01 (3 trials), 0.02 (4 trials), 0.04 (2 trials), and 0.11 mg/kg after use of emulsifiable concentrate formulations, and 0.03 (2 trials), 0.04 (3 trials), 0.05, 0.06, 0.07, 0.10, 0.11, 0.12, 0.15, and 0.18 mg/kg after use of capsule suspension formulations. The residues of the two formulations appeared to be from different populations, higher concentrations generally arising from the capsule suspension formulation, and the Meeting agreed to use the data for the latter formulations for estimating the STMR value and MRL. The concentrations of the combined residues of parathion-methyl and paraoxon-methyl, in rank order (median in italics), in the 13 trials with capsule suspension formulations were: 0.03 (2 trials), 0.04 (3 trials), 0.05, ***0.06***, 0.07, 0.10, 0.11, 0.14, 0.15, and 0.18 mg/kg.

The Meeting estimated a maximum residue level of 0.2 mg/kg, a STMR value of 0.06 mg/kg, and a HR value of 0.18 mg/kg for parathion-methyl in apples.

Parathion-methyl is registered in Italy for use on stone fruit at a spray concentration of 0.023–0.045 kg ai/hl and a PHI of 20 days. The concentrations of residues in *peach* in 18 trials in Italy in 1994 and 1995 that matched GAP were: < 0.01 (3 trials), 0.01 (4 trials), 0.02 (2 trials), and 0.04 mg/kg after use of emulsifiable concentrate formulations and 0.06 (2 trials), 0.08, ***0.09***, ***0.10***, 0.13, 0.16, and 0.22 mg/kg after use of capsule suspension formulations. The concentration of paraoxon-methyl residues did not exceed the LOQ (0.01 mg/kg). The residues of the two formulations appeared to be from different populations, higher concentrations generally arising from the capsule suspension formulation, and the Meeting agreed to use the data for the latter formulations for estimating the STMR value and MRL.

The Meeting estimated a maximum residue level of 0.3 mg/kg, a STMR value of 0.095 mg/kg, and a HR value of 0.22 mg/kg for parathion-methyl in peaches expressed for the whole fruit.

Parathion-methyl is registered in France for use on *grape* at an application rate of 0.3 kg ai/ha and a PHI of 21 days. In 18 trials conducted in France in accordance with the GAP, the concentrations of residues were: < 0.01 (8 trials) and 0.02 mg/kg from the use of emulsifiable concentrate formulations and 0.05 (2 trials), 0.09 (2 trials), ***0.10*** (3 trials), 0.13, and 0.41 mg/kg after use of capsule suspension formulations. In one trial, the concentration found at day 28 was used because it was higher than that at day 21. In two further trials, the concentrations at day 21 were not available because of a sample mix-up, and the residues for day 28 (0.41 and 0.02 mg/kg) were used.

In Spain, parathion-methyl is registered for use on grapes at a spray concentration of 0.045–0.059 kg ai/hl and a PHI of 21 days. Four trials in Spain conducted in accordance with the French GAP resulted in a concentration of < 0.01 mg/kg in the two trials of use of emulsifiable concentrate formulations and 0.05 and 0.13 mg/kg after use of capsule suspension formulations. Eight valid trials in Italy at the Spanish GAP (spray concentrations of 0.046–0.068 kg ai/hl; PHI, 21 days) resulted in concentrations of parathion-methyl residues of < 0.01 (5 trials) and 0.01 mg/kg after use of

emulsifiable concentrate formulations and 0.12 and 0.18 mg/kg after use of capsule suspension formulations. Paraoxon-methyl was not measured in the Italian trials and was not detected at the GAP PHI in the other trials. The residues of the two formulations appeared to be from different populations, higher concentrations generally arising from the capsule suspension formulation, and the Meeting agreed to use the data for the latter formulations for estimating the STMR value and MRL. The concentrations of parathion-methyl residues in grapes, in rank order, in the 13 trials with capsule suspension formulations were: 0.05 (3 trials), 0.09 (2 trials), ***0.10*** (3 trials), 0.12, 0.13 (2 trials), 0.18, and 0.41 mg/kg.

The Meeting estimated a maximum residue level of 0.5 mg/kg, a STMR value of 0.10 mg/kg, and a HR value of 0.41 mg/kg for parathion-methyl in grapes.

Parathion-methyl is registered in the USA for use on *cabbage* at 0.56–1.7 kg ai/ha, with a PHI of 10 days for 0.56 kg ai/ha and 21 days for higher rates. A series of trials conducted in 1988 and 1989 with either six or seven applications at 1.7 kg ai/ha and a 21-day PHI or with a final application at the lower rate and a PHI of 10 days resulted in the concentrations of parathion-methyl residues in cabbages, including wrapper leaves, of < 0.05 (12 trials) and < 0.5 (4 trials) mg/kg.

In four trials in California with high LOQs, there was analytical interference due to overspray with another pesticide, demeton-*S*-methyl. However, the results of these trials cannot be ignored because paraoxon-methyl residues of 0.08–0.24 mg/kg were recorded. Concentrations of paraoxon-methyl of 0.22 and 0.23 mg/kg were found in cabbages in trials in Florida, where those of parathion-methyl residues were < 0.05 mg/kg. This finding differs from those in other crops where parathion-methyl almost invariably comprises the majority of the residue. The concentrations of paraoxon-methyl residues in the 16 trials, in rank order, were: ***0.05*** (9 trials), 0.07, 0.09, 0.10, 0.13, 0.23, 0.24, and 0.26 mg/kg.

The Meeting estimated a maximum residue level of 0.05 mg/kg, a STMR value of 0.05 mg/kg, and a HR value of 0.26 mg/kg for parathion-methyl in cabbages. The estimated maximum residue level replaces the current recommendation (0.2 mg/kg) for head cabbages.

Parathion-methyl is registered in the USA for use on *pea* for production of dried peas at 0.56–1.1 kg ai/ha, with a PHI of 10 days for 0.56 kg ai/ha and 15 days for higher rates. A series of 12 trials conducted in 1988 and 1989 with either four or six applications at 1.1 kg ai/ha and 15-day PHI or with a final application at the lower rate and a PHI of 10 days resulted in the following concentrations of parathion-methyl residues in dried peas: < 0.05 (4 trials), ***0.06*** (3 trials), 0.07, 0.16, 0.18, 0.19, and 0.24 mg/kg. The concentration of paraoxon-methyl residues did not exceed the LOQ (0.05 mg/kg)in any of the trials.

The Meeting estimated a maximum residue level of 0.3 mg/kg, a STMR value of 0.06 mg/kg, and a HR value of 0.24 mg/kg for parathion-methyl in dried peas. The estimated maximum residue level replaces the current recommendation (0.2 mg/kg) for dried peas.

Parathion-methyl is registered in the USA for use on *bean* for production of dried bean at 0.56–1.7 kg ai/ha with a PHI of 15 days for 0.56 kg ai/ha and 21 days for higher rates. In six trials in four states in 1988, with six applications at 1.7 kg ai/ha and harvesting at 15 days, no parathion-methyl or paraoxon-methyl (< 0.05 mg/kg) was detected. The number of trials was limited, but in view of the absence of detectable residues and use of a shorter PHI in the trials than required by GAP, the Meeting agreed to recommend an MRL. Although no residues were detected, there was no evidence that residues were not present, and the STMR value should be equivalent to the LOQ.

The Meeting estimated a maximum residue level of 0.05* mg/kg, a STMR value of 0.05 mg/kg, and a HR value of 0.05 mg/kg for parathion-methyl in dried beans. The estimated maximum residue level confirms the current recommendation for dried beans.

Parathion-methyl is registered in the USA for use on *potato* at 1.7 kg ai/ha with a PHI of 6 days. In eight trials in five states in 1988 and 1989, with six applications at 1.7 or 1.8 kg ai/ha and harvesting after 5 days, no parathion-methyl or paraoxon-methyl (< 0.05 mg/kg) was detected in the tubers. Two processing trials with exaggerated application rates (3.4 and 8.4 kg ai/ha) also showed no residues. In the study of metabolism in potatoes, with an application rate equivalent to 4.7 kg ai/ha, residues of parathion-methyl (0.001 mg/kg) were found in tubers 5 days after treatment and of paraoxon-methyl (0.002 mg/kg) 21 days after treatment. The Meeting agreed that the finding of very low concentrations of residues (50 times less than the LOQ) even after an exaggerated application rate would allow establishment of STMR and HR values as 'essentially zero'.

The Meeting estimated a maximum residue level of 0.05* mg/kg, a STMR value of 0, and a HR value of 0 mg/kg for parathion-methyl in potatoes. The estimated maximum residue level confirms the current recommendation for potatoes.

Parathion-methyl is registered in the USA for use on *sugar beet* at 0.28–0.43 kg ai/ha with a PHI of 20 days. In eight trials in four states in 1988, with six applications at 0.42 kg ai/ha and harvesting at 20 days, no parathion-methyl or paraoxon-methyl was detected (< 0.05 mg/kg) in the roots. Two processing trials with an exaggerated application rate (2.1 kg ai/ha) also showed no residues.

The Meeting estimated a maximum residue level of 0.05* mg/kg, a STMR value of 0, and a HR value of 0 mg/kg for parathion-methyl in potatoes. The estimated maximum residue level confirms the current recommendation for sugar beets.

Parathion-methyl is registered in the USA for use on *maize* at 0.28–0.56 kg ai/ha with a PHI of 12 days. In 12 trials in nine states in 1988 and 1989, with six applications at 1.1 kg ai/ha and harvesting at 12 days, no paraoxon-methyl was detected (< 0.05 mg/kg) in the grain in any of the 12 trials; no parathion-methyl was detected in 11 trials, but a concentration of 0.09 mg/kg was found in one trial. The Meeting agreed to use the data, even though the application rate was exaggerated (twice the labelled amount) since concentrations < LOQ were found in all but one.

The Meeting estimated a maximum residue level of 0.1 mg/kg, a STMR value of 0.05 mg/kg, and a HR value of 0.09 mg/kg for parathion-methyl in maize.

Parathion-methyl is registered in the USA for use on *rice* at 0.56–0.84 kg ai/ha with a PHI of 15 days. In six trials in four states in 1988, with six applications at 0.89 kg ai/ha and harvesting at 15 or 16 days, the concentrations of residues of parathion-methyl in rice grain were: 0.19, 0.27, 0.30, 0.44, 2.0, and 2.3 mg/kg, and those of combined parathion-methyl and paraoxon-methyl residues were: 0.29, 0.43, ***0.45***, ***0.68***, 2.1, and 2.5 mg/kg.

The Meeting considered that six trials were too few to allow estimation of an MRL for rice, a major commodity, and withdrew the current recommendations of 3 mg/kg for rice, 1 mg/kg for husked rice, and 10 mg/kg for rice straw and fodder.

Parathion-methyl is registered in the USA for use on *wheat* at 0.28–0.84 kg ai/ha with a PHI of 15 days. In nine trials in seven states in 1988 and 1989, with four applications at 1.4 kg ai/ha followed by two applications at 0.84 kg ai/ha and harvesting at 14 days, the concentrations of residues of parathion-methyl in wheat grain were: < 0.05 (2 trials), 0.05, 0.21, 0.29, 0.48, 1.1 (2 trials), and 3.7

mg/kg, and those of combined parathion-methyl and paraoxon-methyl residues were: < 0.05 (2 trials), 0.05, 0.21, ***0.29***, 0.53, 1.2 (2 trials), and 4.1 mg/kg. As the residue is derived mainly from the final application, the first four of the six applications at an exaggerated rate would not have affected the concentration of residue.

The Meeting estimated a maximum residue level of 5 mg/kg, a STMR value of 0.29 mg/kg, and a HR value of 4.1 mg/kg for parathion-methyl in wheat.

Parathion-methyl is registered in the USA for use on *cotton* at 0.15–3.4 kg ai/ha, with a PHI of 5 days for hand-picking and 0 days for mechanical picking. In a trial in 1989, the concentrations of parathion-methyl residues were 9.5 and 22 mg/kg 7 days after application of 3.4 kg ai/ha in a processing trial. In 18 trials in four states in 1998 with 10 applications at 3.4 kg ai/ha and harvesting 1 day after the final application, the concentrations of parathion-methyl in cottonseed were: 0.64, 1.5 (2 trials), 1.7, 1.9, 2.0, 2.5, 3.0, 3.2, 3.5, 3.9, 4.6, 5.4, 5.6, 6.8, 7.4 (2 trials), and 8.9 mg/kg, and those of the combined parathion-methyl and paraoxon-methyl residues were: 0.66, 1.5 (2 trials), 1.7, 1.9, 2.0, 2.5, 3.0, ***3.2***, ***3.5***, 3.9, 4.6, 5.4, 5.6, 6.8, 7.4, 7.5, and 9.1 mg/kg. The concentrations found in the 19 trials were: 0.66, 1.5 (2 trials), 1.7, 1.9, 2.0, 2.5, 3.0, 3.2, *3.5*, 3.9, 4.6, 5.4, 5.6, 6.8, 7.4, 7.5, 9.1, and 22 mg/kg

The Meeting estimated a maximum residue level of 25 mg/kg, a STMR value of 3.5 mg/kg, and a HR value of 22 mg/kg for parathion-methyl in cottonseed.

Parathion-methyl is registered in the USA for use on *rape-seed* at 0.56 kg ai/ha with a PHI of 28 days. In four trials on rape-seed in four states in 1992 with two applications at 0.56 kg ai/ha or two applications at 0.28 kg ai/ha followed by two at 0.56 kg ai/ha and harvesting 28 days after the final application, no parathion-methyl or paraoxon-methyl was detected (< 0.05 mg/kg) in rape-seed. In a further four trials at twice the labelled rate and harvesting at the 28-day PHI, no paraoxon-methyl residues were detected in any trial; parathion-methyl was not detected in three trials, and a concentrationof 0.06 mg/kg was found in the fourth. Although the four trials were conducted at twice the GAP rate, the Meeting considered that the data provided valid support as all the concentrations but one were < LOQ. The estimates of the MRL and the STMR and HR values were based on the results of the GAP trials with support from the trials at twice the labelled rate.

The Meeting estimated a maximum residue level of 0.05 mg/kg, a STMR value of 0.05 mg/kg, and a HR value of 0.05 mg/kg for parathion-methyl in rape-seed.

Parathion-methyl is registered in the USA for use on *alfalfa* at 0.28–1.1 kg ai/ha with a PHI of 15 days. In 18 trials in nine states in 1998 with two applications of 1.1 kg ai/ha per cutting (two to four cuttings in each trial, each cutting being regarded as a separate trial) and cutting 14 or 15 days after the second application, the concentrations of parathion-methyl residues in *alfalfa forage* were: 0.03, 0.09, 0.13, 0.21, 0.24, 0.26, 0.27, 0.31, 0.32 (2 trials), 0.35, 0.38, 0.39, 0.46, 0.54, 0.55, 0.57, 0.66, 0.70, 0.73, 0.74, 0.76, 0.82, 0.84, 0.87, 0.91 (2 trials), 0.92, 1.0, 1.1 (3 trials), 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 2.0, 2.1, 2.2, 2.3, 2.6, 2.7, 5.9, 6.8, 8.5, 8.6, and 11 (2 trials) mg/kg of fresh weight or 0.18, 0.48, 0.51, 0.55, 0.83, 0.93, 1.0 (2 trials), 1.1, 1.2, 1.4, 1.6, 1.7, 1.8, 2.3, 2.4, 2.5 (2 trials), 2.7, 2.8, 2.9, 3.1, 3.3, 3.5, 3.7 (2 trials), 3.8 (2 trials), 4.0, 4.2, 4.5, 5.1 (2 trials), 5.3, 5.4, 5.8, 6.3, 7.0 (2 trials), 8.1, 9.4, 9.8, 11 (2 trials), 15, 32, 33, 36, 41, 47, and 60 mg/kg of dry weight. As moisture was measured in each accompanying control sample, the concentration of residues in each sample could be calculated on a dry weight basis.

The concentrations of combined parathion-methyl and paraoxon-methyl residues in alfalfa forage were: 0.03, 0.09, 0.13, 0.21, 0.24, 0.26, 0.27, 0.31, 0.32 (2 trials), 0.35, 0.38, 0.39, 0.46, 0.54, 0.56, 0.59, 0.68, 0.71, 0.74, 0.75, 0.76, 0.83, 0.84, 0.88, 0.92, 0.94 (2 trials), 1.0, 1.1 (3 trials), 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 2.0, 2.1, 2.2, 2.3, 2.6, 2.7, 6.0, 6.9, 8.6, 8.7, and 11 (2 trials) mg/kg of fresh

weight or 0.18, 0.48, 0.51, 0.55, 0.83, 0.93, 1.0 (2 trials), 1.1, 1.2, 1.4, 1.6, 1.7, 1.8, 2.3, 2.5, 2.6 (2 trials), 2.7, 2.9 (2 trials), 3.2, 3.3, 3.5, ***3.7*** (2 trials), 3.9 (2 trials), 4.1, 4.3, 4.6, 5.1, 5.2, 5.4, 5.5, 5.8, 6.3, 7.1 (2 trials), 8.3, 9.6, 10, 11 (2 trials), 15, 33 (2 trials), 37, 42, 47, and 61 mg/kg of dry weight.

The Meeting estimated a maximum residue level of 70 mg/kg and a STMR value for parathion-methyl in alfalfa forage of 3.7 mg/kg (dry weight).

The concentrations of parathion-methyl residues in *alfalfa hay* were: 0.28, 0.33, 0.36, 0.37, 0.38 (2 trials), 0.39, 0.46, 0.63, 0.64 (4 trials), 0.67, 0.79, 0.81, 0.87, 1.0, 1.2, 1.3 (3 trials), 1.4 (2 trials), 1.5, 1.7 (3 trials), 1.8, 1.9 (3 trials), 2.1, 2.2 (2 trials), 2.3, 2.7, 3.0, 3.4, 3.5, 4.1, 4.2, 4.5, 5.7, 6.4, 8.0, 8.8, 13, 17 (2 trials), and 23 mg/kg of fresh weight or 0.39, 0.41, 0.42 (2 trials), 0.45, 0.49, 0.55 (2 trials), 0.70 (2 trials), 0.90, 1.0, 1.2 (3 trials), 1.3, 1.4 (2 trials), 1.6, 1.7, 1.8, 2.0, 2.1 (3 trials), 2.3 (3 trials), 2.4, 2.7 (2 trials), 3.0, 3.2, 3.5 (2 trials), 3.8, 3.9, 4.6 (2 trials), 5.2, 5.3, 5.7, 8.4, 11 (2 trials), 16 (2 trials), 18, 21, 27, and 57 mg/kg of dry weight.

The concentrations of combined parathion-methyl and paraoxon-methyl residues in alfalfa hay were: 0.28, 0.33, 0.36, 0.37, 0.38 (2 trials), 0.39, 0.46, 0.63, 0.64 (2 trials), 0.65 (2 trials), 0.67, 0.80, 0.82, 0.89, 1.0, 1.2, 1.3 (3 trials), 1.4 (2 trials), 1.5, 1.7 (3 trials), 1.8, 1.9 (3 trials), 2.1, 2.2, 2.3 (2 trials), 2.7, 3.0, 3.4, 3.5, 4.1, 4.3, 4.6, 5.8, 6.5, 8.1, 8.9, 13, 17 (2 trials), and 23 mg/kg of fresh weight or 0.39, 0.41, 0.42 (2 trials), 0.45, 0.49, 0.55 (2 trials), 0.70, 0.71, 0.90, 1.0, 1.2 (3 trials), 1.3, 1.5 (2 trials), 1.6, 1.7, 1.8, 2.1 (2 trials), 2.2 (2 trials), ***2.3*** (2 trials), 2.4 (2 trials), 2.8 (2 trials), 3.0, 3.2, 3.5, 3.6, 3.8, 3.9, 4.6, 4.7, 5.2, 5.4, 5.8, 8.5, 11, 12, 16 (2 trials), 18, 21, 27, and 57 mg/kg of dry weight.

The Meeting estimated a maximum residue level of 70 mg/kg and a STMR value of 2.3 mg/kg for parathion-methyl in alfalfa fodder (dry weight).

The concentrations of residues in pea hay or *pea fodder* (described in the trials as dried forage) and of *pea straw* were measured in the trials on dried peas (see above) carried out according to GAP. The concentrations of parathion-methyl residues in pea hay or pea fodder (12 trials) were: 0.35, 0.37, 0.55, 0.66, 1.0, 3.4, 3.6, 4.2, 5.2, 7.6, 9.5, and 58 mg/kg. The concentrations of parathion-methyl residues in pea straw (11 trials) were: 0.71, 0.72, 0.82, 1.1, 2.6, 3.1, 3.5, 4.9, 5.0, 13, and 27 mg/kg. One of these trials was invalid because of an excessively contaminated control plot. Because dried forage and pea straw are included in the commodity pea hay or pea fodder (dry), the data on dried forage and pea straw were combined, and the higher residue in each trial was used to estimate the MRL and STMR value. The concentrations of parathion-methyl were then: 0.71, 0.72, 0.82, 1.0, 1.1, 4.2, 4.9, 5.0, 5.2, 9.5, 13, and 58 mg/kg, and those of the combined parathion-methyl and paraoxon-methyl residues become: 0.71, 0.90, 0.92, 1.0, 1.1, ***4.3***, ***5.3***, 5.4, 5.5, 9.7, 13, and 59 mg/kg.

Allowing for the standard 88% of dry matter in pea hay (FAO, 1997, p. 125), the Meeting estimated a maximum residue level of 70 mg/kg and a STMR value of 5.5 mg/kg (4.8/0.88) for parathion-methyl in pea hay or pea fodder (dry weight).

As noted above, parathion-methyl is registered in the USA for use on peas for production of dried peas. In 11 trials conducted in 1988 and 1989 with four or six applications at 1.1 kg ai/ha and a 15-day PHI or with a final application at 0.56 kg ai/ha and a PHI of 10 days, the concentrations of parathion-methyl residues in *pea vine* were: < 0.05 (4 trials), 0.08, 0.17, 0.20, 0.21, 0.23, 1.6, and 7.3 mg/kg of fresh weight. In the same trials, the concentrations of parathion-methyl residues on *succulent forage* were: < 0.05 (4 trials), 0.07, 0.08 (2 trials), 0.13, 0.15, 0.17, 4.9, and 8.2 mg/kg. As succulent forage is included in the commodity pea vines, the data for pea vines and succulent forage were combined, and the higher residue value in each trial was used to estimate the MRL and STMR value. The concentrations of parathion-methyl data are then: < 0.05 (4 trials), 0.08, 0.17 (2 trials), 0.20, 0.21,

0.23, 4.9, and 8.2 mg/kg, and those of the combined parathion-methyl and paraoxon-methyl residues become: < 0.05 (4 trials), 0.08, ***0.17***, ***0.20***, 0.23, 0.27, 0.28, 4.9, and 8.2 mg/kg.

Allowing for the standard 25% of dry matter in pea vines (FAO, 1997, p. 125), the Meeting estimated a maximum residue level of 40 mg/kg and a STMR value of 0.74 mg/kg (0.185/0.25) for parathion-methyl in green pea vines (dry weight).

As noted above, parathion-methyl is registered in the USA for use on beans for production of dried beans. In six trials in four states in 1988 with six applications at 1.7 kg ai/ha and sampling of *bean forage* at a 21-day PHI, the concentrations of parathion-methyl residues were: < 0.05 (2 trials), 0.10, ***0.11***, 0.31, and 0.66 mg/kg. The residues are expressed on a fresh weight basis because the percent dry matter for bean forage is not provided in the *FAO Manual* (FAO, 1997).

The Meeting estimated a maximum residue level of 1 mg/kg and a STMR value of 0.11 mg/kg for parathion-methyl in green bean forage. The estimated maximum residue level confirms the current MRL recommendation for bean forage of 1 mg/kg.

As noted above, parathion-methyl is registered in the USA for use on wheat. In six trials in four states, *wheat hay* was cut 14 days after a final treatment with parathion-methyl at four applications of 1.4 kg ai/ha followed by two applications of 0.84 kg ai/ha, which was considered to represent GAP for the purposes of measuring residues. The resulting concentrations of residues in wheat hay were: 0.10, 0.17, 0.33, 0.98, 1.0, and 1.2 mg/kg (fresh weight).

In nine trials on wheat in seven states in 1988 and 1999, parathion-methyl was applied four times at 1.4 kg ai/ha and then twice at 0.84 kg ai/ha, and *wheat straw* was harvested 14 days after the final treatment. The concentrations of parathion-methyl residues in wheat straw were: 0.13, 0.28, 0.34, 0.55, 0.79, 0.85, 2.6, 3.7, and 5.7 mg/kg (fresh weight).

The data on wheat hay and straw were combined to support a MRL for wheat straw and fodder. The concentrations of the combined parathion-methyl and paraoxon-methyl residues in wheat straw and fodder become: 0.10, 0.13, 0.23, 0.28, 0.34, 0.49, 0.67, ***0.91***, 0.94, 1.1, 1.2, 2.4, 2.8, 4.1, and 5.9 mg/kg.

Allowing for the standard 88% of dry matter in wheat hay and straw (FAO, 1997, p. 127), the Meeting estimated a maximum residue level of 10 mg/kg and a STMR value of 10 and 1.03 mg/kg (0.91/0.88) for parathion-methyl in wheat straw and fodder (dry weight). The estimated maximum residue level confirms the current recommendation for wheat straw and fodder of 10 mg/kg.

Parathion-methyl is registered in the USA for use on forage grasses at 0.56–0.84 kg ai/ha with a PHI of 15 days for cutting or grazing. In 15 trials in six states in 1988 with six applications at 0.86–0.89 kg ai/ha and sampling of *pasture grass hay* after 15 days, the concentrations of parathion-methyl residues were: 0.05, 0.12, 0.19, 0.21, 0.25, 0.31, 0.50, ***0.54***, 0.64, 0.66, 0.96, 1.0, 1.4, 1.6, and 2.5 mg/kg (fresh weight), and those of the combined parathion-methyl and paraoxon-methyl residues in pasture grass hay were: 0.14, 0.23, 0.25, 0.26, 0.32, 0.45, 0.54, ***0.60***, 0.66, 0.70, 0.96, 1.1, 1.5, 1.6, and 2.9 mg/kg of fresh weight.

Allowing for the standard 88% of dry matter in hay of pasture grasses (FAO, 1997, p. 124), the Meeting estimated a maximum residue level of 5 mg/kg and a STMR value of 0.68 mg/kg (0.60/0.88) for parathion-methyl in grass hay or fodder (dry weight). The estimated maximum residue level confirms the current recommendation for hay or fodder of grasses of 5 mg/kg.

As noted above, parathion-methyl is registered in the USA for use on sugar beets at 0.28–0.43 kg ai/ha with a PHI of 60 days for *sugar beet top* used as animal fodder. Neither parathion-methyl residues nor paraoxon-methyl residues were detected in beet fodder in six trials in four states in 1988, with six applications at 0.42 kg ai/ha and fodder harvesting at 60 days. Residues of parathion-methyl are unlikely to occur after such an interval, but there was no evidence that residues were not present.

The Meeting estimated a maximum residue level of 0.05* mg/kg and a STMR value of 0.05 mg/kg for parathion-methyl in beet tops and fodder (fresh weight). The estimated maximum residue level confirms the current recommendation for sugar beet leaves or tops of 0.05* mg/kg.

Fate of residues during processing

The Meeting received information on the fate of incurred residues of parathion-methyl and paraoxon-methyl during the processing of apple, peach, grapes, olive, soya bean, wheat, maize, rice, cottonseed, sunflower seed, rape-seed, and hops, and processing factors were calculated for processed commodities derived from these raw agricultural commodities. The studies on apple, peach, grape, wheat, maize, cottonseed, and rape-seed are summarized below because maximum residue levels are estimated for these raw agricultural commodities.

Processing factors were calculated for parathion-methyl residues only and for combined parathion-methyl and paraoxon-methyl residues. As parathion-methyl is the dominant component of the residue, the processing factor is similar with the two calculations. Nevertheless, since these factors are used in calculating the concentrations of residues in processed foods for the purpose of estimating dietary intake, that for the combined residue was used when available. When the concentration of residues in the processed commodity did not exceed the LOQ, the processing factor was calculated from the LOQ and was prefixed with a 'less than' symbol (<).

The factors for parathion-methyl in *apple* processed to dry pomace were: 4.0, 4.3, 4.5, and 8.0 (mean, 5.2) and those for juice were: < 0.25, < 0.5, < 0.33, and < 1. As no residues were detected in juice, the value < 0.25 is the best estimate of the juice processing factor. Application of these factors to the STMR value and MRL for apples provides a STMR-P value of 0.31 mg/kg and a HR-P value of 1.04 mg/kg for dry apple pomace and a STMR-P value for juice of 0.015 mg/kg.

Parathion-methyl residues were not detected in *peach* juice in two trials in which the calculated processing factors were < 0.33 and < 0.5; the best estimate is < 0.33. Application of the factor to the STMR value for peaches provides a STMR-P value for peach juice of 0.031 mg/kg.

The factors for the processing of *grape* to raisins were: 1.3 (2 trials), 1.5, and 1.6 (mean, 1.4). Application of the factor to the STMR value and MRL for grapes provides a STMR-P value of 0.014 mg/kg and a HR-P value of 0.70 mg/kg for raisins. The Meeting estimated a maximum residue level for parathion-methyl in dried grapes of 1 mg/kg. The factors for processing of grapes to juice were: 0.06, < 0.07, < 0.10, and < 0.11, and the best estimate is 0.06. Application of the factor to the STMR value for grapes provides a STMR-P value for grape juice of 0.0006 mg/kg. The factors for processing of grapes to wine were: < 0.077, < 0.083, 0.13, 0.19, 0.20, and 0.22 (mean, 0.15). Application of the factor to the STMR value for grapes provides a STMR-P value for wine of 0.0015 mg/kg.

The factors for processing of *wheat* to bran were 2.0 and 2.4 (mean, 2.2). Application of the factor to the STMR value for wheat provides a STMR-P value for wheat bran of 0.64 mg/kg. Application of the factor to the MRL for wheat gives a HR value for parathion-methyl in wheat bran of 11.0 mg/kg. The Meeting estimated a maximum residue level for parathion-methyl in wheat bran of 10 mg/kg, which confirms the current recommendation for unprocessed wheat bran.

The factors for processing of wheat to flour were: 0.29, 0.42, and 0.45 (mean, 0.39). Application of the factor to the STMR value for wheat provides a STMR-P value for flour of 0.11 mg/kg. Application of the factor to the MRL for wheat gives a HR value for parathion-methyl in flour of 1.95 mg/kg. The Meeting estimated a maximum residue level for parathion-methyl in wheat flour of 2 mg/kg.

The processing factors for dry milling of *maize* were: 0.21, 0.19, and 0.74 (mean, 0.38) for grits, 0.47 and 0.45 (mean, 0.46) for meal, 0.41 for flour, 0.31 for crude oil, and 0.26 for refined oil. The processing factors for wet milling of maize were: < 0.09 for starch, 1.33 for crude oil, and 1.03 for refined oil. Application of the factors to the STMR value and MRL for maize provides a STMR-P value of 0.023 mg/kg and a HR-P value of 0.046 mg/kg for meal and STMR-P values of 0.021 mg/kg for maize flour, 0.019 mg/kg for grits, and 0.0045 mg/kg for starch. Application of the factor for flour (0.41) to the MRL for maize gives a HR value for parathion-methyl in maize flour of 0.041 mg/kg. The Meeting estimated a maximum residue level for parathion-methyl in maize flour of 0.05 mg/kg.

The two processes resulted in different concentrations of residues in maize oil. The processing factors for oils were 0.31 and 0.26 with the dry process and 1.33 and 1.03 with the wet process. The Meeting agreed to use the values for the wet process, which, when applied to the STMR value for maize, provide STMR-P values of 0.067 mg/kg for crude oil and 0.051 mg/kg for refined oil. Application of the factors to the MRL for maize provides HR values for parathion-methyl of 0.13 mg/kg in crude maize oil and 0.10 mg/kg in refined maize oil. The Meeting estimated maximum residue levels for parathion-methyl in crude maize oil and edible maize oil of 0.2 and 0.1 mg/kg, respectively.

The processing factors for *cottonseed* milling were: 0.04 and 0.12 (mean, 0.08) for meal, 0.41 and 0.47 (mean, 0.44) for hulls, 0.81 and 0.07 (mean, 0.44) for crude oil, and 0.59 and 0.06 (mean, 0.33) for refined oil. Application of the factors to the STMR value and MRL for cottonseed provides a STMR-P value of 0.28 mg/kg and a HR-P value of 2.0 mg/kg for meal, a STMR-P value of 1.5 mg/kg and a HR-P value of 9.7 mg/kg for hulls, and STMR-P values of 1.54 mg/kg for crude oil and 1.16 mg/kg for refined oil. Application of the factors to the MRL for cottonseed provides HR values for parathion-methyl of 11 mg/kg in crude cottonseed oil and 8.25 mg/kg in refined cottonseed oil. The Meeting estimated a maximum residue level of 10 mg/kg for parathion-methyl in both crude and edible cottonseed oil.

The processing factors for *rape-seed* were: 0.22 for meal, 2.4 for crude oil, and 2.0 for refined oil. Application of the factors to the STMR value and MRL for rape-seed provides a STMR-P and a HR-P value for rape-seed meal of 0.011 mg/kg and a STMR-P value of 0.12 mg/kg for crude oil and 0.10 mg/kg for refined oil. Application of the factors for oil to the MRL for rape-seed provides HR values for parathion-methyl of 0.12 mg/kg in crude rape-seed oil and 0.10 mg/kg in refined rape-seed oil. The Meeting estimated a maximum residue level for parathion-methyl in crude and edible rape seed oil of 0.2 mg/kg.

Residues in animal and poultry commodities

The Meeting estimated the dietary burden of parathion-methyl residues in farm animals on the basis of the diets listed in Appendix IX of the *FAO Manual* (FAO, 1997). Calculation from MRLs (or HR values) provides concentrations in feed suitable for estimating MRLs for animal commodities, while calculation from STMR values for feed is suitable for estimating STMR values for animal commodities. The percent dry matter is considered to be 100% for MRLs and STMR values expressed in dry weight.

Commodity	MRL or HR	Group	% dry matter	MRL/dry matter	Percent of diet			Concentration of residue (mg/kg)		
					Beef cattle	Dairy cows	Poultry	Beef cattle	Dairy cows	Poultry
Alfalfa fodder	70	AL	100	70	70	60		49.0	42.0	
Alfalfa forage (green)	70	AL	100	70						
Bean forage (green)	1	AL	25	4.0						
Pea hay or pea fodder (dry)	70	AL	100	70						
Pea vines (green)	40	AL	100	40						
Hay or fodder (dry) of grasses	5	AS	100	5.0						
Wheat straw and fodder, dry	10	AS	100	10	10	10		1.00	1.00	
Sugar beet leaves or tops	0.05	AV	23	0.22						
Maize meal	0.046	CF	85	0.054						
Maize	0.1	GC	88	0.11						
Wheat	5	GC	89	5.62		10	80		0.56	4.49
Apple pomace (dry)	1.04	AB	100	1.04						
Cottonseed hulls	9.7		90	10.8	20	20		2.16	2.16	
Cottonseed meal	2.00		88	2.27			20			0.45
Rape-seed meal	0.011		88	0.025						
Total								52.2	45.7	4.95

Commodity	STMR	Group	% dry matter	STMR/dry matter	Percent of diet			Concentration of residue (mg/kg)		
					Beef cattle	Dairy cows	Poultry	Beef cattle	Dairy cows	Poultry
Alfalfa fodder	2.3	AL	100	2.3						
Alfalfa forage (green)	3.7	AL	100	3.7	45	10		1.67	0.37	
Bean forage (green)	0.11	AL	25	0.44						
Pea hay or pea fodder (dry)	5.5	AL	100	5.5	25	50		1.38	2.75	
Pea vines (green)	0.74	AL	100	0.74						
Hay or fodder (dry) of grasses	0.68	AS	100	0.68		10			0.07	
Wheat straw and fodder, dry	1.03	AS	100	1.03	10	10		0.10	0.10	
Sugar beet leaves or tops	0.05	AV	23	0.22						
Maize meal	0.023	CF	85	0.027						
Maize	0.05	GC	88	0.06						
Wheat	0.29	GC	89	0.33			80			0.26
Apple pomace (dry)	0.31	AB	100	0.31						
Cottonseed hulls	1.54		90	1.71	20	20		0.34	0.34	
Cottonseed meal	0.28		88	0.32			20			0.06
Rape-seed meal	0.011		88	0.01						
Total								3.5	3.6	0.32

The dietary burdens of parathion-methyl in animal commodities (expressed as dry weight) used to estimate the MRL and STMR value are: 52 and 3.5 ppm for beef cattle, 46 and 3.6 ppm for dairy cows, and 4.95 and 0.32 ppm for poultry.

No suitable studies of farm animal feeding were available to allow conversion of the dietary burden of residues to MRLs and STMR values for animal and poultry commodities. The Meeting was informed that such studies will be initiated shortly.

Further work or information

Desirable

- Feeding studies in farm animals to permit estimation of maximum residue levels and STMR values for animal and poultry commodities
- Information on the stability of paraoxon-methyl in fruits in frozen storage
- Information on the metabolism of parathion-methyl in fruits

Dietary risk assessment

Chronic intake

The periodic review of parathion-methyl resulted in recommendations for new and revised MRLs and new STMR values for raw and processed commodities. Data on consumption were available for 17 food commodities and were used in calculating the dietary intake. The results are shown in Annex 3.

The international estimated daily intakes from the five GEMS/Food regional diets, based on estimated STMR values, represented 3–30% of the ADI. The Meeting concluded that the long-term intake of residues of parathion-methyl from uses that have been considered by the JMPR is unlikely to present a public health concern.

Short-term intake

The IESTI for parathion-methyl was calculated for the food commodities (and their processing fractions) for which maximum residue levels and STMR values were estimated and for which consumption data were available. The results are shown in Annex 4. The IESTI represented 0–30% of the acute RfD for the general population and 0–80% of the acute RfD for children.

The Meeting concluded that the acute intake of residues of parathion-methyl from uses that have been considered by the JMPR is unlikely to present a public health concern.

4.19 Pyrethrins (063)

Residue and analytical aspects

Pyrethrins are a naturally occurring insecticide containing six biologically active, chemically related esters. The esters of chrysanthemic acid (pyrethrins I) are pyrethrin 1, cinerin 1, and jasmolin 1, and the esters of pyrethric acid (pyrethrins II) are pyrethrin 2, cinerin 2, and jasmolin 2. Pyrethrin 1 is the predominant compound. Pyrethrins are used not only on crops but also used as a direct spray on farm animals.

Pyrethrins were last evaluated for residues in food by the JMPR in 1972. At its twenty-sixth session, the CCPR noted that these compounds were originally scheduled for toxicological and residue evaluation by the 1994 Joint Meeting but the evaluation of residues had been postponed to 2000.

For this periodic review, the manufacturer provided relevant supporting studies, information on GAP, and data on residues in citrus, small fruits, leafy vegetables, cucurbits, peppers, tomatoes,

beans, peas, root and tuber vegetables, celery and mustard seeds after foliar treatment, and beans, prunes, and peanuts after treatment in a warehouse. National maximum residue limits, information on GAP, and data on residues in celeriac and leeks were provided by the governments of Australia, Germany, and Poland.

Metabolism

Animals and birds

Rats were given [^{14}C]pyrethrin 1 either at a single dose of 10 mg/kg bw or a single dose of 100 mg/kg bw for males and 50 mg/kg bw for females, or unlabelled pyrethrin 1 at a dose of 10 mg/kg bw for 14 days before a single radiolabelled dose. Excreta were collected periodically, and the animals were killed 7 days after the dose. The radiolabel in urine after all treatments represented 32–47% of the administered dose in males and 49–57% in females. In faeces, the amount of radiolabel represented 55–71% of the dose in males and 50–52% in females. In both males and females, the concentration of excreted radiolabel peaked after 12–24 h, but animals given the repeated low dose excreted the radiolabel more rapidly than those given single doses. The concentrations of radiolabel in tissues represented a greater proportion of the administered dose in males than in females given the single doses: 0.46 and 0.35% for males and females at the low dose and 0.87 and 0.57% at the high dose, respectively, while the values were similar after the repeated doses: 0.57 and 0.59% for males and females, respectively.

Pyrethrin 1 is metabolized in rats by cleavage of the ester bond to form the corresponding acid and alcohol and by oxidation at a number of sites. The parent compound and five metabolites were identified in excreta. The major metabolite in urine after all dosing regimens was chrysanthemic dicarboxylic acid, and the compounds excreted predominantly in faeces were pyrethrin 1 and metabolite E, a dihydrodiol product of pyrethrin 1 (with oxidation on the vinyl group of the alcohol portion of the molecule), via formation of a monocarboxylic acid intermediate. Chrysanthemic dicarboxylic acid and metabolite E represented over one-third of the radiolabel excreted with all three regimens in both male and female rats. Males and females metabolized pyrethrin 1 similarly, regardless of the dose.

In another study, the percent of radiolabel excreted in urine and faeces and the percent of the dose represented by chrysanthemic dicarboxylic acid in urine did not differ appreciably when rats received the compound in corn oil, food slurry, or dimethyl sulfoxide. Repeated administration of high doses of pyrethrin apparently decreased the percent total radiolabel excreted and the percent excreted as chrysanthemic dicarboxylic acid.

Lactating goats received [^{14}C]pyrethrin 1 by gavage at a dose of 7.6, 8.3 (dietary burden, 10 ppm), or 179 mg/kg bw (dietary burden, 300 ppm) or dermally as an 1.8% oil- or water-based formulation The goats given the low oral dose or the dermal dose received [^{14}C]pyrethrin 1 once a day for 5 days, and those given the high dose received it once a day for 3 days. *Laying hens* were dosed orally for 5 days at 7.7 or 475 ppm or treated dermally with a 1% oil- or water-based solution.

Most of radiolabel in goats and hens treated orally was found in the excreta (75 and 89% of the administered radiolabel, respectively). Goats treated dermally retained 44–72% of the dose on the application site, while hens retained 12–37% of the dose. Milk from the goat given the high oral dose contained up to 2.8 ppm equivalents of pyrethrin 1 after 24–36 h, while that of goats given the low dose contained 0.10 ppm. In the milk of animals treated dermally, the radiolabel represented 0.003–0.007 ppm with the water-based solution and 0.010–0.014 ppm with the oil-based solution. In goat tissues, the concentrations of radiolabel in liver (7.7 ppm pyrethrin equivalents), kidney (7.3 ppm), and fat (3.6 ppm) were highest with the high oral dose. Muscle of these animals contained 0.45–0.48 ppm

of pyrethrin equivalents. In goats at the low dose, the concentrations of radiolabel in fat, liver, and kidney were 0.36–0.42 ppm, and those in muscle were 0.02–0.03 ppm. Fat contained the highest concentration in the dermally treated goats (0.08 and 0.04 ppm).

Up to the second day, the radiolabel was found mainly in the white of eggs of treated hens, with 0.93 ppm of pyrethrin equivalents at the high oral dose and 0.002–0.006 ppm with the low oral dose and dermal treatment. After 48 h, the radiolabel was concentrated in the yolk, representing 1.6–4.3 ppm at termination of the study in the group given the high oral dose and 0.010–0.05 ppm in those given the low oral and dermal treatments. The concentration of radiolabel in tissues of birds given the high oral dose ranged from 1.4 ppm in muscle to 15 ppm in liver. In those given the low oral dose, most of the radiolabel was found in gizzard (1.1% of the administered dose), kidney (0.42%), and liver (0.34%). In the tissues of dermally treated hens, most of the radiolabel was found in treated skin (3.8 and 5.3%) and fat (0.19 and 0.15% of the administered dose).

In both goats and hens, pyrethrin 1 can undergo hydrolysis to form *trans*-chrysanthemic acid, which is readily conjugated *in vivo* to the corresponding -glucuronic conjugate and to other conjugates of the free acid. Pyrethrin 1 is converted by oxidation to a corresponding monocarboxylic acid derivative, which, like the parent, can be oxidized to a dihydrodiol (metabolite E). Both of these metabolites can be hydrolytically converted to chrysanthemic dicarboxylic acid. The parent molecule can also undergo reduction at the , -unsaturated ketone position to form metabolite G.

Goats and hens given the low oral or dermal dose had low concentrations (< 0.2 mg/kg) of pyrethrin 1 and its metabolites in all edible products. Those at the high dose had the highest concentrations of parent compound in fat (2.3 mg/kg in goats and 8.8 mg/kg in hens), milk (1.5 mg/kg), and eggs (0.97 mg/kg). In goats, no metabolites were detected in milk (< 0.01 mg/kg), while liver and kidney had the highest concentrations of individual metabolites (0.078–3.3 mg/kg). Chrysanthemic acid was the major metabolite in eggs (0.39 mg/kg) and liver (3.0 mg/kg) of hens given the high dose.

The metabolism of pyrethrins in animals and birds thus involves hydrolysis of the ester bond and oxidation at various sites. The main metabolite in rat excreta is chrysanthemic dicarboxylic acid. The parent compound, chrysanthemic acid, monocarboxylic acid, and dicarboxylic acid were also present in milk and eggs. In goats, chrysanthemic acid represented up to 7% of the residue in muscle, up to 15% in liver, and three times the concentration of the parent compound in kidney. In egg white, the concentration of chrysanthemic acid was as much as 10 times that of the parent compound in liver.

Plants

The fate of pyrethrins after five foliar applications of [^{14}C]pyrethrin 1 on *leaf lettuce*, *potatoes*, and *tomatoes* at 0.56 kg ai/ha (10 times the GAP rate) was investigated. The plants were placed in boxes lined with polyethylene sheeting and exposed to sunlight in a greenhouse with a translucent plastic roof and sides composed of bird- and rodent-proof wire. Tomato leaves and fruit and potato leaves and tubers were collected 5 days after treatment, and lettuce leaves 0 and 10 days after treatment. Pyrethrin 1 degraded extensively, yelding at least eight and as many as 19 extractable metabolites, showing similar metabolic pathways in each crop. The identified metabolites were chrysanthemic acid derivatives produced by cleavage of the ester bond.

Only minimal uptake or translocation of pyrethrin 1 and its degradation products occurs, probably because of the relatively low lipophilicity (log P_{OW} ~ 6) of the parent compound, which results in little tendency to cross the cuticle of plant surfaces and enter the largely aqueous regions in which metabolism by enzymes can occur. The concentrations of total radiolabel in potato and tomato leaves (550 and 365 mg/kg pyrethrin equivalents, respectively) were 1000 and 200 times higher than

those in the tuber and fruit, respectively. In lettuce, the concentrations of radiolabel (36 mg/kg) and pyrethrin 1 (14.7 mg/kg) at day 0 had decreased substantially 10 days after the last application, to 10 and 0.25 mg/kg, respectively. The concentrations of pyrethrin 1 and its metabolites in tomato fruit and potato tubers were 0.03–8% of the corresponding values in leaves (< 0.004–0.42 mg/kg). The lower concentrations of both total residues and parent pyrethrin 1 in potato tubers than in tomato fruit reflect the limited direct application to tomatoes, which are sheltered by the leaf canopy, whereas in potatoes the radiolabel can reach the tubers only by translocation. The concentrations of all metabolites found in lettuce decreased between day 0 and day 10, except that of *trans*-chrysanthemic acid-hydroxide-cyclo, which increased from 1.5 mg/kg pyrethrin equivalents to 2.1 mg/kg within the same period.

Environmental fate

Degradation in soil

The half-time of [^{14}C]pyrethrin 1 applied at a rate of 10 mg/kg to sandy loam soil exposed to natural sunlight at 24 °C for up to 24 h was 12.9 h, and no degradate contained > 10% of the applied radiolabel. Only CO_2 was identified.

The degradation of [^{14}C]pyrethrin 1 was studied after application at a rate of 1.0 mg/kg to a sandy loam soil under aerobic conditions at 25 ± 1 °C in the dark for up to 181 days. Pyrethrin 1 and extractable species metabolized to bound residues and thereafter to CO_2, with a half-life of about 3.2 days. Chrysanthemic acid was identified in organic extracts of the treated soil, its concentration reaching a maximum of about 4% of the initial concentration of pyrethrin 1 after 3 days. Three other degradates were observed at concentrations of 5–10% of the amount of pyrethrin 1 applied. About 6–10% of the applied radiolabel was present as humic acid, fulvic acid, and humin fractions.

The terrestrial dissipation of pyrethrins applied as an end-use formulation to bare soil was studied in California, Georgia, and Michigan (USA) at a nominal rate of 0.52 kg ai/ha (total amount of pyrethrins applied throughout a season). The half-times were 1–2 h, and within 1 day of application pyrethrin had dissipated in the 0–15-cm soil horizon to below the limit of detection, 0.10 mg/kg for total pyrethrins. Pyrethrin 1 was not detected at depths < 15 cm.

The volatility of [^{14}C]pyrethrin 1 applied at a rate of 0.56 kg ai/ha (10 times the labelled rate) to sandy loam soil was studied at 50 and 75% of the field moisture capacity and flow rates of 100 and 300 ml/min. After 30 days, most the radiolabel remained in the soil, 37–43% having been extracted and 33–38% bound. [^{14}C]Pyrethrin 1 in soil extracts represented 1.9% (75% moisture, 300 ml/min) to 9.1% of the applied dose (50% moisture, 100 ml/min). Four degradates that were soluble in organic solvents were observed in the extracts. The radiolabel trapped in ethylene glycol was mainly associated with chrysanthemic acid, in all but one test system, with two other organic degradates (representing 4–9% of the applied radiolabel) and with pyrethrin 1 (< 0.05–0.19% of the applied dose). The volatility rates were not affected by air flow or by the amount of moisture in the soil. The volatility from soil of pyrethrin *per se* was considerably lower (2–12 10^6 mg/cm^2 per h) than that of all volatile components (0.001 mg/cm^2 per h).

The adsorption and desorption of [^{14}C]pyrethrin 1 were studied at concentrations of 0.05, 0.09, 0.50, and 0.81 mg/kg in sandy loam, silty clay loam, silt loam, and sand soils. A 1:100 ratio of soil to solution and a 3-h equilibration time were used for both adsorption and desorption experiments. The adsorption constants varied from 268 to 430 and the desorption constants from 965 to 2600. The K_{OC} value ranged from 12 472 to 448 257, indicating that pyrethrin 1 is immobile.

Fate in water and sediment systems

The aqueous photolysis of a test solution of [^{14}C]pyrethrin 1 containing 0.3 mg/kg at pH 7 that was exposed to natural sunlight for up to 72 h at 25 ± 1 °C was investigated. Within 1 h of exposure, the concentration of pyrethrin 1 had decreased to 47%, and that of the *E* isomer reached 44% of the applied dose. After 30 days, these values were 7 and 12%, respectively. The overall photolytic half-time for the two isomers was 11.8 h.

The hydrolysis of [^{14}C]pyrethrin 1 at 0.4 mg/kg in buffered aqueous solutions at pH 5, 7, and 9 was investigated for 30 days in the dark at 25 °C. Pyrethrin 1 was stable at pH 5 and 7 (5% degradation); at pH 9, the half-time was 17 days. At this pH, approximately 35% of the radiolabel was found as pyrethrin 1 after 30 days, and 61% as chrysanthemic acid, the main radiolabelled degradate. A single non-radiolabelled degradate, a dimer of a relative molecular mass of 320, was isolated. The proposed pathway for formation of the dimer involves hydrolysis of pyrethrin 1 to pyretholone, rapid elimination of water from pyretholone to form the corresponding cyclopentadienone, and Diels-Alder condensation of the cyclopentadienone to form the observed dimer.

The anaerobic and aerobic aquatic degradation of [^{14}C]pyrethrin 1 was studied at 25 ± 1 °C in a dark system prepared from sandy loam hydrosoil. The treatment rate was approximately 1 mg/kg, and incubation proceeded for 364 days under anaerobic and for 30 days under aerobic conditions. Pyrethrin 1 degraded with a half-time of 86 and 10.5 days under anaerobic and aerobic conditions, respectively. The concentration of radiolabel increased during incubation in the supernatant but decreased in soil, as the bound residues and the amount were lost as the amount of CO_2 increased. After 30 days, the concentration of radiolabel in soil under anaerobic conditions was higher in the organosoluble fraction (55%) than in bound residues (31%). Under aerobic conditions, the situation was reversed, 51% of the applied radiolabel being bound and 22% in the organosoluble fraction in the same period. After 364 days under anaerobic conditions, 24% of the applied radiolabel was present in the supernatant and 62% in soil, mostly bound or as CO_2.

The principal extractable species under anaerobic conditions were pyrethrin 1 and three degradates, chrysanthemic acid, cyclopropane diacid, and jasmolin 1. Chrysanthemic acid appeared after 14 days (representing 9.2% of the applied dose); the concentration remained stable until day 270 and decreased to 5.3% by 364 days. Cyclopropane acid was detected at day 270, representing 11% of the applied dose, increasing to 15% at the end of the study. Jasmolin 1 was first detected at day 90 at concentrations that remained stable until the end of the study (9–10 % of the applied dose).

Under aerobic conditions, the principal extractable species were pyrethrin 1 and chrysanthemic acid, corresponding to 72 and 2.5% of the applied dose, respectively, 3 days of application. The concentration of pyrethrin reached a minimum after 30 days (15% of the dose), and that of chrysanthemic acid reached a maximum after 21 days (22% of the dose). In both anaerobic and aerobic systems, radiolabel was present in humic acid, fulvic acid, and humin fractions, corresponding to approximately 6–23% of the applied dose. Chrysanthemic acid was found in the fulvic acid fraction.

Thus, pyrethrin 1 is an immobile compound with low volatility. In water in the dark, it degrades with a half-time of 10.5 days under aerobic conditions and 86 days under anaerobic conditions, while the photolytic half-time is ~ 12 h. Degradation occurs more rapidly under basic conditions, with a half-time of 17 days at pH 9. In soil, pyrethrin 1 degrades in the dark with a half-time of 3.2 days, while the photolysis half-time is 13 h. The main metabolite detected in water and soil was chrysanthemic acid.

Methods of analysis

Methods for determining residues of pyrethrins in vegetables and animal products were presented. In all methods, the extracts are analysed by gas chromatography with electron capture detection. Pyrethrins I are quantified by summing the responses of the three esters, pyrethrin 1, cinerin 1, and jasmolin 1, which are determined individually in the chromatographic method. No adjustment is made for the specific responses of the esters in the electron capture detector (pyrethrin 1 has a stronger response) or for relative molecular mass. As pyrethrin II esters degrade during analysis, the concentration of total pyrethrins is estimated from the proportions of esters of pyrethrins I and pyrethrins II in the formulation. In food trials, where the concentration of pyrethrins II represents 81.5% of that of pyrethrins I, the concentrations of pyrethrins I were multiplied by 1.81 to obtain the corresponding concentrations of total pyrethrins. In animals, where the concentration of pyrethrins II represents 92.0% of that of pyrethrins I, the concentrations of the latter were multiplied by 1.92 to obtain the corresponding concentrations of total pyrethrins. A world standard pyrethrum extract is available for calibration of the method from the Pyrethrum Board of Kenya.

Samples of raw and processed agricultural commodities are extracted in an organic solvent and cleaned-up by silica gel adsorption or silica gel–alumina adsorption. The LOQ for total pyrethrins was 0.04 mg/kg in all matrices. The recovery of pyrethrins I ranged from 61 to 139%, with a mean of 93%.

In a second method, used for food items treated in warehouses, samples are extracted with either an organic solvent and water for low-fat foods (navy beans and prunes) or an organic solvent for high-fat foods (peanuts), followed by clean-up with liquid–solid partition. The LOQ for pyrethrins I was 0.1 mg/kg, and the limit of detection was 0.05 mg/kg. The method was validated for each matrix by analysis of at least four fortifications. The reported recoveries ranged from 65 to 120%.

A third method was used to analyse edible products from laying hens and dairy cattle and is also applicable for enforcement of tolerances for pyrethrin in animal-derived commodities. In this method, samples are extracted with an organic solvent, and the extract is cleaned-up by silica gel adsorption or silica gel–alumina adsorption (for liver, kidney, skin, muscle, eggs, and fat). The LOQs were 0.02 mg/kg for milk and eggs and 0.04 mg/kg for all animal tissues, as total pyrethrins. The recoveries ranged from 67 to 112% at 1, 10, and 100 times the LOQ, with standard deviations of 1.5 to 10%.

Stability of residues in stored samples

The stability of pyrethrin residues in frozen samples was examined in representative commodities for which trials at 1 mg/kg were submitted. In samples of broccoli, bean pods, vines, and hay, dry orange pulp, dry and wet tomato pomace, liver, and kidney, only 35–70% of the concentration of pyrethrins remained after 12–27 months of storage. In all the other commodities, pyrethrin was stable, > 80% remaining after storage.

Definition of the residue

On the day of application, pyrethrin 1 is the major compound in lettuce, chrysanthemic dicarboxylic acid being the only degradation product present at a level > 10% of that of the pyrethrin residue (17%). Pyrethrin 1 is degraded extensively by photolysis 10 days after application to plants, and no predominant metabolite is formed. The toxicological evaluation of pyrethrins (Annex 6, reference 86) was based on studies conducted with pyrethrum extract. The ADI and acute RfD derived take into account the toxicity of metabolites of the six related esters.

The Meeting agreed that the residue definition for compliance with the MRL and for estimating dietary intake is total pyrethrins, calculated as the sum of the six biologically active pyrethrin esters: pyrethrin 1, pyrethrin 2, cinerin 1, cinerin 2, jasmolin 1, and jasmolin 2, after calibration with the world standard pyrethrum extract.

Pyrethrins are fat soluble, with log P_{ow} values of 5.9 for pyrethrin 1 and 4.3 for pyrethrin 2.

Results of supervised trials

All of the available trials were conducted in the USA during 1992–96 according to the maximum GAP value of 10 foliar applications of 0.056 kg ai/ha with no PHI, unless otherwise specified. As esters of pyrethrins II degrade during analysis, total pyrethrin concentrations are estimated from the proportions of esters of pyrethrins I and pyrethrins II in the formulation (pyrethrins II representing 81.5% of that of pyrethrins I) and multiplying the concentrations of pyrethrins I by 1.81.

Seven trials were conducted with *citrus* fruit: two on *lemon*, three on *orange*, and two on *grapefruit*. The concentrations of residues (median in italics) were < *0.04* (6 trials) and 0.04 mg/kg. The Meeting agreed that, although seven trials are normally considered to be too few to allow recommendation of a MRL for a major commodity such as citrus, the concentrations of residues found, which were below or at the LOQ, reflect the amounts of pyrethrin residues remaining after foliar application according to GAP. The Meeting recommended a MRL of 0.05 mg/kg, a STMR value of 0.04 mg/kg, and a HR value of 0.04 mg/kg for pyrethrins in citrus.

One trial was conducted in *blackberry*, two in *blueberry*, and one in *cranberry*, in which the concentrations of residues in fruit were 0.10, 0.08, 0.07, and 0.05 mg/kg, respectively. Two trials were conducted in *strawberries*, giving residue concentrations of 0.11 and 0.12 mg/kg, and one trial was carried out in grapes, with a concentration of 0.17 mg/kg. As insufficient data were available from trials performed according to GAP, the Meeting could not recommend a MRL for pyrethrins in berries, strawberries, or grapes.

Three trials were conducted in *broccoli*, giving residue values of < 0.04, 0.06, and 0.08 mg/kg. In three trials in *cabbage*, the residue concentrations were 0.05, 0.12, and 0.39 mg/kg. Cabbage heads with wrapper leaves removed had a residue concentration < 0.04 mg/kg. As insufficient data were available from trials performed according to GAP, the Meeting could not recommend a MRL for pyrethrins in broccoli and cabbage.

Eight trials were conducted in curcubits: two in *cantaloupe*, two in *cucumber*, and four in *summer squash*. The concentrations of residues in fruit were < 0.04 (7 trials) and 0.04 mg/kg. The Meeting agreed to recommend a MRL of 0.05 mg/kg, a STMR value of 0.04 mg/kg, and a HR value of 0.04 mg/kg for pyrethrins in fruiting curcubits.

Three trials were conducted in *pepper* and three in *tomato*, giving residue concentrations < 0.04 mg/kg in the fruit. The Meeting agreed that residues on fruiting cucurbits can be used to support the data on peppers and tomatoes and recommended a MRL of 0.05 mg/kg, a STMR value of 0.04 mg/kg, and a HR value of 0.04 mg/kg for pyrethrins in tomatoes and peppers.

Nine trials were conducted in leafy vegetables. The concentrations of residues were 0.08 and 0.16 mg/kg in head *lettuce*, 0.52 and 0.56 mg/kg in leafy lettuce, 1.8 mg/kg in *radish* leaves, 0.75 and 1.0 mg/kg in *spinach*, and 0.64 and 0.90 mg/kg in *mustard green*. As the values in the different commodities are not within the same range, they could not be combined. As insufficient data from

trials performed according to GAP were submitted, the Meeting could not recommend a MRL for pyrethrins in lettuce, radish leaves, spinach, and sugar beet leaves.

In two trials conducted in succulent *bean*, the residue concentrations in seeds with pods were < 0.04 and 0.13 mg/kg. In two trials in succulent *pea*, the concentrations in seeds with pods were < 0.04 and 0.09 mg/kg. As insufficient data from trials performed according to GAP were submitted, the Meeting could not recommend a MRL for pyrethrins in succulent beans and peas.

Seven trials were conducted in root and tuber vegetables: one in *carrot*, three in *potato*, two in *radish*, and four in *sugar beet*. The concentration of residues in the roots of all commodities was < 0.04 mg/kg. A study of metabolism in potatoes treated with 10 times the maximum labelled rate showed that the concentration of pyrethrin 1 in tubers was 0.004 mg/kg 5 days after application. The Meeting agreed that it is unlikely that residues would be present in roots after a 0-day PHI and recommended a MRL of 0.05* mg/kg, a STMR value of 0, and a HR value of 0.04 mg/kg for pyrethrins in root and tuber vegetables.

Two trials were conducted in *celery*, giving residue concentrations of 0.16 and 0.70 mg/kg. When the leaves were removed, these values fell to < 0.04 and 0.07 mg/kg, respectively. As insufficient data were available from trials performed according to GAP, the Meeting could not recommend a MRL for pyrethrins in celery.

One trial was conducted in *mustard seed*, in which the concentration of residues was < 0.04 mg/kg. As insufficient data were available from trials performed according to GAP, the Meeting could not recommend a MRL for pyrethrins in mustard seeds.

In four trials conducted in beans, the concentrations of residues in *bean vine*, in rank order, were: 0.08, 0.22, 0.38, and 1.6 mg/kg. In *bean hay* samples dried for 2–6 days in the open air, the concentrations were 0.08, 0.09, 0.43, and 0.48 mg/kg. The concentrations in forage were 0.24 and 0.32 mg/kg. Residues were measured in *pea vines* in four studies, the concentrations of residues being 0.16, ***0.53***, ***0.62***, and 0.82 mg/kg, and those in *pea hay* dried for up to 14 days in the field or in a greenhouse were 0.03, 0.07, 0.45, and 0.46 mg/kg. The concentrations in forage were 0.62 and 1.6 mg/kg.

The Meeting agreed that residues in bean vines are within the same population as residues in pea vines and can be used to support a recommendation for pea vines. The concentrations were: 0.08, 0.16, 0.22, ***0.38***, ***0.53***, 0.62, 0.82, and 1.6 mg/kg of fresh vine. When the median (0.53 mg/kg) and the maximum (1.6 mg/kg) values were corrected for moisture content (75%, FAO Manual, p. 125), they were 2.15 and 6.4 mg/kg, respectively, of dry matter. The Meeting recommended a MRL of 10 mg/kg and a STMR value of 2.15 mg/kg for pyrethrins in dried pea vines.

The Meeting agreed that residues in bean and pea hay represent a single residue population and can be combined. The concentrations were: 0.03, 0.07, 0.08, ***0.09***, ***0.43***, 0.45, 0.46, and 0.48 mg/kg of fresh weight. When the median (0.26 mg/kg) and the maximum (0.48 mg/kg) values were corrected for the moisture content of pea hay (12%, FAO, 1997, p. 125), the values were 0.295 and 0.545 mg/kg, respectively, of dry weight. The Meeting recommended a MRL of 1 mg/kg and a STMR value of 0.295 mg/kg for pyrethrins in bean hay and pea hay or fodder

Two trials were conducted in *sugar beet leaf*, giving residue concentrations of 0.05 and 0.08 mg/kg. As insufficient data from trials performed according to GAP were submitted, the Meeting could not recommend a MRL for pyrethrins in sugar beet leaves

Twenty trials were conducted with bagged *navy bean* treated in a warehouse with pyrethrins at up to 10 applications of the labelled rate by a space spray (0.05 kg ai/1000 m^3) and by contact spray

(0.003 kg ai/100 m^2). The concentration of residues in samples collected after each treatment was < 0.05 mg/kg (limit of detection). The LOQ in the trials was 0.10 mg/kg.

In two trials conducted on *dried bean* and two on *dried pea* treated by foliar application, the concentration in seeds was < 0.04 mg/kg. The Meeting recommended a MRL of 0.1 mg/kg, a STMR value of 0.05, and a HR value of 0.05 mg/kg for pyrethrins in pulses based on post-harvest use.

Twenty trials were conducted on harvested *peanut* treated in a warehouse with 10 applications at the labelled rate by a space spray (0.05 kg ai/1000 m^3) and by contact spray (0.003 kg ai/100 m^2). The concentrations in samples collected after each treatment with a space spray were < 0.05 (3 trials) (limit of detection), < 0.10 (3 trials) (LOQ), 0.12, 0.16, 0.21, and 0.23 mg/kg. Under contact spray conditions, the concentration was < 0.05 (10 trials) mg/kg. The concentrations after post-harvest use were: ***< 0.05*** (13 trials), < 0.10 (3 trials), 0.12, 0.16, 0.21, and 0.23 mg/kg. The Meeting recommended a MRL of 0.5 mg/kg, a STMR value of 0.05 mg/kg, and a HR value of 0.23 mg/kg for pyrethrins in peanuts after post-harvest treatment.

Trials were conducted with bagged, harvested *prune* treated in a warehouse with 10 applications at the labelled rate by a space spray (0.003 kg ai/1000 m^3) and by contact spray (0.003 kg ai/100 m^2). The concentrations in samples collected after each treatment under space spray conditions were < 0.05 (8 trials) (limit of detection), < 0.10 (LOQ), and 0.11 mg/kg. Under contact spray conditions, the concentrations were < 0.05 (8 trials) and < 0.10 (2 trials) mg/kg. The concentrations after post-harvest use were: ***< 0.05*** (16 trials), < 0.10 (3 trials), and 0.11 mg/kg. The Meeting noted that the residues in prunes can be extensive and recommended a MRL of 0.2 mg/kg, a STMR value of 0.05 mg/kg, and a HR value of 0.11 mg/kg for pyrethrins in dried fruits after post-harvest treatment.

Fate of residues during processing

Oranges treated 10 times at 0.28 kg ai/ha (five times the labelled rate) were processed in a laboratory into juice, molasses, dry peel (dry pulp), and oil, simulating commercial operations. The concentrations of residues were 0.06 mg/kg in fruit, decreased in molasses with a processing factor of 0.69, and not detected in juice (processing factor, < 0.66). The residue was concentrated in dry pulp, with a processing factor of 8.55, and in oil, with a factor of 20.3. On the basis of a STMR value of 0.04 mg/kg and the processing factors derived, the Meeting estimated a STMR-P value of 0.026 for citrus juice, 0.0276 for citrus molasses, 0.342 for dry citrus fruit, and 0.812 for citrus oil.

Grapes treated 10 times at 0.28 kg ai/ha (five times the labelled rate) were processed in a laboratory into juice, simulating commercial operations, into wet and dry pomace, and into raisins. The concentration of residues in fruit (0.08 mg/kg) increased after processing to wet and dry pomace, with processing factors of 1.32 and 5.03, respectively. Residues were not detected in raisins, raisin waste, or juice (processing factor, < 0.48).

Tomatoes treated 10 times at 0.28 kg ai/ha (five times the labelled rate) were processed in a laboratory, simulating commercial operations, into wet pomace, dry pomace, puree, and juice. The concentration of residues in fruit (0.08 mg/kg) increased after processing to wet and dry pomace, with processing factors of 8.8 and 20.2, respectively. No residues were detected in puree or juice (processing factor, < 0.48). On the basis of a STMR value of 0.04 mg/kg and the processing factors derived, the Meeting estimated STMR-P values of 0.352 for wet pomace, 0.808 for dry tomato pomace, and 0.018 for tomato juice and tomato puree.

Succulent *beans* treated 10 times at 0.28 kg ai/ha (five times the labelled rate) were processed into cannery waste as a composite sample of leaves, whole pods, and pod tips. The concentrations of residues were 0.34 mg/kg in pods and 1.2 mg/kg in cannery waste (processing factor, 3.5).

Potatoes treated 10 times at 0.28 kg ai/ha (five times the labelled rate) were processed in a laboratory by separate procedures simulating commercial practice, into chips, wet peel from the granule-making process, and granules, equivalent to flakes. No residues were detected in raw or processed commodities.

Sugar beets treated 10 times at 0.28 kg ai/ha (five times the labelled rate) were processed in a laboratory, simulating commercial operations, into dehydrated pulp, molasses, and refined sugar. No residues were detected in raw or processed commodities.

Residues in animal commodities

Lactating dairy cows were given pyrethrin orally and dermally daily for up to 27 days, at an oral dose of 5, 15, or 50 mg/kg and a dermal dose of 89 mg/day. The concentration of pyrethrins in milk peaked between 7–11 days at 0.03, 0.09, and 0.20 mg/kg at the three doses, respectively. At the low and medium dose, these concentrations remained approximately the same until the end of the study; at the high dose, the concentration decreased to 0.11 mg/kg at day 27. Residues were detected only in fat (at 0.43 mg/kg) of animals at the low dose, but concentrations of 0.05–1.5 mg/kg were found in liver, kidney, muscle, and fat of animals at the higher doses.

The dietary burden was calculated from the MRL and STMR values for pea vines estimated by the Meeting (10 and 2.15 mg/kg, respectively) and the percent of the diet of dairy cows (50%) as described in the *FAO Manual* (FAO, 1997, pp. 121–127). The dietary burden based on the MRL is 5 ppm, and that based on the STMR value is 1.1 ppm.

The Meeting agreed that dermal exposure can contribute to residues in animal commodities, as the study of metabolism in goats treated dermally with a 1.8% oily solution showed detectable residues in milk, liver, and fat (0.010, 0.002, and 0.013 mg/kg, respectively). The Meeting also agreed that the concentrations of residues found in studies in which animals were exposed orally and dermally are overestimates, as it is unlikely that animals would be exposed by both routes on a daily basis. The Meeting considered that an estimate of a maximum residue level for pyrethrins in cattle commodities was precluded.

Hens were dosed both dermally and orally with pyrethrin 1 for 35–37 days. The oral doses were 3, 9, and 30 mg/kg in the diet, and the dermal dose was 332 mg/28 m^3 [~ 12 mg/m^3] per day, expressed as total pyrethrins, representing the maximum labelled rate for spraying of premises. Except for one sample from a bird at the intermediate dose, which contained a concentration of 0.02 mg/kg on day 3, residues of pyrethrins in eggs were only just detectable on day 7 after the highest dose, at concentrations of 0.02–0.04 mg/kg. The concentrations of residues in edible tissues of birds at all doses were at or around the LOQ (0.038 mg/kg) in liver and muscle. In skin, they were 0.18, 0.17, and 0.25 mg/kg, and those in fat were 0.06, 0.23, and 0.27 mg/kg at the three doses, respectively.

No recommendations are available for commodities used for poultry feed that would allow calculation of the dietary burden for poultry. The Meeting agreed that it is unlikely that hens would be exposed to pyrethrins both orally and dermally on a daily basis and that the concentrations in poultry commodities derived from such studies will be overestimates. The Meeting considered that an estimate of a maximum residue level for pyrethrins in poultry commodities was precluded.

Residues in food in commerce or at consumption

A total of 745 domestic and imported samples of food products in the USA were analysed in 1998 for residues of pyrethrins. They were not detected in any of the products.

National maximum residue limits

MRLs were provided from 33 countries in Africa, Asia, Europe, and North America. The values ranged from 0.05* to 5 mg/kg. The residue definition is the sum of the six esters, as total pyrethrins.

Further work or information

Desirable

Feeding studies in ruminants

Dietary risk assessment

Chronic intake

The ADI for pyrethrins is 0–0.04 mg/kg bw. The international estimated daily intake was calculated for commodities consumed by humans for which STMR values were estimated by the Meeting. The results are shown in Annex 3. The international estimated daily intakes from the five GEMS/Food regional diets, based on estimated STMR values represented 0% of the ADI. The Meeting concluded that the intake of residues of pyrethrins resulting from uses that have been considered by the JMPR is unlikely to present a public health concern.

Short-term intake

The acute RfD for pyrethrins is 0.2 mg/kg bw. The IESTI was calculated for the commodities for which STMR and HR values were estimated and for which data on consumption were available. The results are shown in Annex 4. The IESTI represented 0–3% of the acute RfD for the general population and 0–8% of that for children.

4.20 Pyriproxyfen (200)

Residue and analytical aspects

Pyriproxyfen was first evaluated in 1999, and MRLs were recommended for citrus fruits, cottonseed and its processed commodities, and animal commodities. Information on the fate of pyriproxyfen during the processing of oranges, listed by the 1999 JMPR as desirable, has been provided.

Fate of residues during processing

Data from supervised trials on *oranges* in USA in 1995 and 1996 were provided. In one trial, involving one treatment at the normal rate and one at an exaggerated rate, residues of pyriproxyfen and the metabolite 4′-hydroxypyriproxyfen were measured on peel and peeled orange and on whole orange. In another trial, pyriproxyfen was applied at an exaggerated rate, and the harvested oranges (200 kg) were processed by a procedure simulating commercial processing for juice and oil production.

In the trial at the exaggerated rate, the concentrations of residues were 0.41 mg/kg in peeled fruit and 0.01 mg/kg in the edible portion, resulting in a processing factor of 0.024 for orange to peeled orange. When treatment was at the normal rate, the concentrations of residues were 0.22 mg/kg in whole oranges and not detected (< 0.01 mg/kg) in peeled orange. No residues of 4′-

hydroxypyriproxyfen were detected (< 0.01mg/kg) in the edible portion with either treatment. The 1999 JMPR reported that pyriproxyfen residues were not detected (< 0.01 mg/kg) in the edible portion in 24 tests during trials on citrus.

The calculated processing factors in the trial of simulated commercial processing were: 75 for oranges to oil, 6.3 for oranges to dry pulp (used as animal feed), and < 0.03 for oranges to juice. Application of the factors to the median concentration (0.12 mg/kg) in whole oranges in the 11 trials that complied with GAP (Annex 6, reference 86) resulted in STMR-P values of 9.0 mg/kg for orange oil, 0.76 mg/kg for dried citrus pulp, and 0.0036 mg/kg for orange juice. Application of the factor for dried orange pulp (6.3) to the recommended maximum residue level for oranges (1 mg/kg) results in a HR-P value for dried citrus pulp of 6.3 mg/kg.

Residues in animal commodities

The Meeting estimated the dietary burden of pyriproxyfen residues in farm animals on the basis of the diets listed in Appendix IX of the *FAO Manual* (FAO, 1997). Calculation from MRLs (or HR values) provides concentrations in feed suitable for estimating MRLs for animal commodities, while calculation from STMR values for feed is suitable for estimating STMR values for animal commodities. The percent dry matter is considered to be 100% for MRLs and STMR values expressed in dry weight. The information on cotton was evaluated in 1999.

Commodity	MRL or HR	Group	% dry matter	MRL/dry matter	Percent of diet		Concentration of residue (mg/kg)	
					Beef cattle	Dairy cows	Beef cattle	Dairy cows
Cotton gin trash	5		100	5.00	20	20	1.00	1.00
Cottonseed (with lint)	0.05	SO	88	0.057	25	25	0.01	0.01
Cottonseed meal	0.005	SO	89	0.006				
Citrus pulp, dry	6.3	AB	91	6.9	20	20	1.38	1.38
Total							2.40	2.40
Commodity	STMR	Group	% dry matter	STMR/dry matter	Percent of diet		Concentration of residue (mg/kg)	
					Beef cattle	Dairy cows	Beef cattle	Dairy cows
Cotton gin trash	0.91		100	0.91	20	20	0.18	0.18
Cottonseed (with lint)	0.01	SO	88	0.011	25	25	0.00	0.00
Cottonseed meal	0.001	SO	89	0.001				
Citrus pulp, dry	0.76	AB	91	0.80	20	20	0.17	0.17
Total							0.35	0.35

The dietary burdens of pyriproxyfen for estimation of MRLs and STMR values (residue concentrations in animal feeds expressed as dry weight) are 2.4 and 0.35 ppm for beef cattle and 2.4 and 0.35 ppm for dairy cows.

The dietary burdens of cattle estimated by the 1999 JMPR were 1.0 ppm for estimation of the MRL and 0.18 ppm for estimation of the STMR value. As the value of 1.0 ppm was derived from the 3 ppm feeding level in the animal transfer studies, the revised dietary burden (2.4 ppm) does not change the recommended maximum residue level. Similarly, the revised dietary burden for the STMR value (0.35 ppm) does not change the estimated STMR values for animal commodities

Dietary risk assessment

Chronic intake

The 1999 JMPR concluded that the intake of pyriproxyfen from the five GEMS/Food regional diets represents essentially 0% of the ADI and that the intake of pyriproxyfen resulting from uses that have been considered by the JMPR is unlikely to present a public health concern. The additional information on citrus processing does not change that conclusion.

Short-term intake

The 1999 JMPR concluded that an acute RfD for pyriproxyfen is unnecessary. The Meeting therefore concluded that the short-term dietary intake of pyriproxyfen residues is unlikely to present a risk to consumers.

4.21 THIABENDAZOLE (065)

Residue and analytical aspects

Thiabendazole was evaluated by the Joint Meeting in 1997 within the periodic review programme of the CCPR, when it recommended the withdrawal of MRLs for a number of commodities. At its twenty-third session, the CCPR (ALINORM 99/24A, para 65) decided to retain the Codex MRLs for apples, citrus fruits, pears, and strawberries, as new data would become available for review by the Joint Meeting in 2000. Information was made available to the present Meeting on analytical methods for animal products, GAP, and the results of supervised trials on mandarins, oranges, apples, pears, strawberries, avocados, mangoes, papayas, melons, and potatoes.

Thiabendazole is registered in many countries for use as a fungicide before and after harvesting and as a drug in veterinary and human medicine. Its main use in plant protection is after harvesting.

Methods of analysis

Two methods were validated at a LOQ of 0.03 mg/kg for thiabendazole, benzimidazole, and 5-hydroxy-thiabendazole in meat (dairy and poultry), poultry skin with attached fat, eggs, cattle liver, and cattle kidney. After fortification at 0.03 mg/kg, the mean recovery was 70–99% for thiabendazole, 66–94% for benzimidazole, and 72–105% for 5-hydroxythiabendazole.

Definition of the residue

The 1997 JMPR defined the residue in plant products for compliance with MRLs and for estimation of dietary intake as thiabendazole. For animal products, the residue is defined as the sum of thiabendazole and 5-hydroxythiabendazole for compliance with MRLs, and as the sum of thiabendazole, 5-hydroxythiabendazole, and its sulfate conjugate for estimation of dietary intake.

Results of supervised trials and stability of residues in stored samples

Trials of one or two post-harvest applications were conducted in Spain in 1998 on *orange* and *mandarin*. In eight trials (four on mandarins, four on oranges), the application rate of 2.0 g ai/l corresponded to the Spanish use pattern for single drench applications (0.5–2.2 g ai/l). In five trials (two on mandarins, three on oranges), the rate of 1.8 g ai/l (drench) plus 6.0 g ai/t (spray) were conducted according to the Spanish use pattern for double drench and spray applications (1.0–1.8 g

ai/l drench plus 3.3–7 g ai/t spray). Four trials (two on mandarins, two on oranges) of spraying at 3.0 g ai/t plus 4.0 g ai/t were conducted for a new registration and did not correspond to an existing GAP; these data could therefore not be used to estimate maximum residue levels.

The concentrations of residues in mandarins (whole fruit) remained stable or decreased slightly during storage up to 15 days. The concentrations were higher after longer single drench treatment (30 s versus 150 s) and with more treatments (single versus double). With the double treatments, there was no difference between short and long drenching times. The concentrations of residues of thiabendazole in trials that complied with the GAP (median in italics) were 0.50, 0.65, ***1.4***, ***1.6***, and 2.2 (2 trials) mg/kg in the whole fruit and *0.01* (3 trials), *0.03*, 0.04, and 0.09 mg/kg in the pulp.

The concentrations of residues in oranges (whole fruit) remained stable or decreased slightly during storage up to 15 days. The concentrations were higher after longer single drench treatment (30 s versus 150 s) and with more treatments (single versus double). With the double treatments, there was no difference between short and long drenching times. The concentrations of residues of thiabendazole in trials that complied with the GAP were: 0.40, 0.53, 1.1, ***1.2***, 1.6 (2 trials), and 1.9 mg/kg in the whole fruit and < *0.01* (4 trials) and 0.01 (3 trials) mg/kg in the pulp.

The Meeting observed that the results for mandarin and orange are comparable. Since this is to be expected from post-harvest treatment, the Meeting decided to combine the data on these two citrus fruits. The concentrations of residues of thiabendazole in trials on mandarin and orange that complied with the GAP were: 0.40, 0.50, 0.53, 0,65, 1.1, 1.2, ***1.4***, 1.6 (3 trials), 1.9, and 2.2 (2 trials) mg/kg in the whole fruit and < 0.01 (4 trials), ***0.01*** (6 trials), 0.03, 0.04, and 0.09 mg/kg in the pulp.

The Meeting estimated a maximum residue level of 3 mg/kg for thiabendazole in unwashed whole citrus fruit arising from double post-harvest application (drench plus spray) to replace the previous recommendation of 10 mg/kg for citrus fruit. The Meeting estimated a STMR value of 0.01 mg/kg and a HR value of 0.09 mg/kg for thiabendazole in the edible part of citrus fruit (pulp).

Post harvest residue trials were conducted in northern France in 1998 and in Spain in 1991 on *apple* and *pear* treated by a single post-harvest dip or drenching at 1.1 g ai/l. Eight trials carried out in France were evaluated against the Belgian use pattern for apples and pears of 1.0 g ai/l. The concentrations of residues were maintained during storage up to 30 days, and those after dipping or drenching for 45–120 s were similar. Four trials in Spain, two on apples and two on pears, were conducted according to the national use pattern (0.9–1.3 g ai/l) but could not be evaluated because of conflicting analytical results and insufficient detail in the description of the analytical methods used. The concentrations of thiabendazole residues in the trials in France were: 1.5, 1.6, ***1.7*** (4 trials), 1.9, and 2.0 mg/kg**.**

One trial of the use of a paste formulation of thiabendazole for the treatment of wounds was conducted in Germany in 1998 on apple trees before flowering. The trial was according to the national GAP. It confirmed that residues would not be expected in pome fruit after wound treatment (< 0.05 mg/kg).

Although all the information available came from trials on apples, the Meeting considered that similar residues would be found in pears treated after harvesting. The Meeting therefore estimated a maximum residue level of 3 mg/kg for thiabendazole in pome fruit (apple and pear) arising from single post-harvest applications. Since no new data were provided on pre-harvest uses on apples and pears, the Meeting agreed to withdraw the recommendation of 10 mg/kg for apples and 10 mg/kg for pears for these uses. The Meeting estimated a STMR value of 1.7 mg/kg and a HR value of 2.0 mg/kg for thiabendazole in pome fruit (apple and pear) arising from single post-harvest applications.

Seven trials were conducted in Spain in 1989, 1991, and 1993 on *strawberry* sprayed once before harvesting. The concentrations of residues decreased with longer intervals before harvesting (up to 14 days). The trials in 1991 and 1993 (one in macro-tunnels and four in the open field) at 90 g ai/hl and the trials in 1989 (one under plastic and one in the open field) at 70 g ai/hl were conducted according to the Spanish use pattern (Annex 6, reference 80, p. 795: 0.30–0.90 kg ai/ha, 45–90 g ai/hl; PHI, 3 days). The concentrations of residues were similar in trials conducted indoors and in the open field. The concentrations of thiabendazole in trials that complied with the Spanish GAP were: 0.43, 1.3, ***1.6*** (2 trials), 2.3, 2.6, and 2.7 mg/kg.

On the basis of the seven Spanish trials, the Meeting estimated a maximum residue level of 5 mg/kg, a STMR value of 1.6 mg/kg, and a HR value of 2.7 mg/kg for strawberries.

Eighteen trials of post-harvest application were conducted on *avocado* in South Africa in 1977 and Costa Rica in 1996. The concentrations of residues decreased during storage. The trials in South Africa (one at 3.0 g ai/l and one at 6.0 g ai/l) were not conducted according to the national use pattern (0.35–1.36 g ai/l), but the use pattern in Kenya (1.1–3.4 g ai/l) can be used to evaluate the trial conducted at 3.0 g ai/l, which showed a residue concentration on the day of treatment of 3.8 mg/kg in stoneless fruit. The 16 trials in Costa Rica, conducted at 3.25 g ai/l of suspension concentrate formulations applied by dip or spray were also evaluated against the Kenyan use pattern. Spray application resulted in higher concentrations than a 3-min dip. The concentrations of thiabendazole in trials that complied with the Kenyan GAP were: 3.8, 4.8, 5.0, 5.6, 6.0, 6.2, 6.7, 6.9, ***7.0***, 7.1, 7.8, 8.0, 8.1, 8.9, 11 (2 trials), and 14 mg/kg in stoneless fruit. In the two South African trials, residues were measured in both stoneless fruit and flesh 0, 3, and 7 days after treatment, providing ratios of residue in flesh versus stoneless fruit of 0.13 ± 0.02.

According to the Codex classification, the portion of the commodity to which the MRL applies and which is analysed is the whole commodity after removal of the stone but calculated on the basis of the whole fruit. The manufacturer provided a study which indicated that the avocado stone contributes about 15% to the weight of the whole fruit. Therefore, the concentrations of residues were multiplied by a factor of 1/1.15 = 0.87, resulting in concentrations of 3.3, 4.2, 4.4, 4.9, 5.2, 5.4, 5.8, 6.0, ***6.1***, 6.2, 6.8, 7.0 (2 trials), 7.7, 9.6 (2 trials), and 12 mg/kg in the whole fruit.

In order to obtain the values for the edible portion of avocado, the concentrations in stoneless fruit were multiplied by the ratio of 0.13 for concentrations in flesh versus stoneless fruit obtained in the South African trials. This yielded concentrations in avocado flesh of 0.5, 0.6, 0.7 (2 trials), 0.8 (2 trials), ***0.9*** (4 trials), 1.0 (2 trials), 1.1, 1.2, 1.4 (2 trials), and 1.8 mg/kg.

The Meeting estimated a maximum residue level of 15 mg/kg for thiabendazole in avocado (whole fruit) arising from a single post-harvest application. The Meeting estimated a STMR value of 0.9 mg/kg and a HR value of 1.8 mg/kg for thiabendazole in the edible portion of avocado.

Twelve trials on *mango* treated by dip or spray after harvesting were conducted in Brazil in 1994 and Belize in 1996. For the trials in Brazil (two at 1.98 g ai/l and two at 3.96 g ai/l by dipping in a wettable powder formulation), no national use pattern was available, but that in Venezuela (drenching; 0.9–1.8 g ai/l) can be used to evaluate the two trials at 1.98 g ai/l. The concentrations of residues on the day of treatment were < 0.03 and 0.03 mg/kg for pulp; those in whole fruit were not reported. For the eight trials in Belize (at 2.5 g ai/l by dipping or spraying with suspension concentrate formulations), no national use pattern was available, but that of Guatemala (1.0–2.5 g ai/l) can be used. The concentrations of residues in stoneless fruit (with peel) were: 1.9, 2.1, and *2.6* mg/kg after dipping and ***3.1***, 3.9, 4.3, and 4.6 mg/kg after spraying. The Meeting noted that, contrary to what

might be expected, spray application resulted in marginally higher concentrations of residues. It nevertheless decided to combine the data sets.

According to the Codex classification, the portion of the commodity to which the MRL applies and which is analysed is the whole commodity after removal of the stone but calculated on the basis of the whole fruit. The manufacturer provided a study which indicated that the mango stone contributes 20–23% to the weight of the whole fruit. Therefore, the concentrations of residues were multiplied by a factor of 1/1.20 = 0.83, yielding values of 1.6, 1.7, ***2.2*** (2 trials), ***2.6***, 3.2, 3.6, and 3.8 mg/kg in the whole fruit.

The Meeting estimated a maximum residue level of 5 mg/kg for thiabendazole in whole mangoes arising from a single post-harvest application. The Meeting estimated a STMR value of 2.85 mg/kg and a HR value of 4.6 mg/kg for thiabendazole in stoneless mangoes, since insufficient information on the residue in the edible portion was available.

Eight trials were conducted in Costa Rica in 1996 on *papaya* treated after harvesting at 2.0 g ai/l by dipping or spraying with suspension concentrate formulations. They were evaluated in comparison with the GAP in the USA (1.0–2.0 g ai/l). The concentrations of thiabendazole were: 3.2, 3.5, ***3.8*** (3 trials), 4.2, and 5.1 (2 trials) mg/kg.

The Meeting estimated a maximum residue level of 10 mg/kg for thiabendazole in whole papayas arising from a single post-harvest application. The Meeting estimated a STMR value of 3.8 mg/kg and a HR value of 5.1 mg/kg in whole papayas, as information was not available on the residue in the edible portion.

Trials were conducted in Spain in 1997 on *melon* in plastic greenhouses sprayed three times before harvesting. Eight trials at three applications of 0.9 kg ai/ha (200 g ai/hl) were conducted according to the Spanish use pattern (Annex 6, reference 80, p. 795: 0.45–0.90 kg ai/ha; 68–90 g ai/hl; PHI, 3 days). In four of the trials, residues were measured only 0 and 7 days after treatment. Data from day 0 in these trials and from day 3 in the other four trials were used, except when the values obtained after the longer PHI were higher. The concentrations in whole fruit were: 0.19 (2 trials), 0.31, ***0.42***, ***0.44***, 0.53, 0.57, and 0.82 mg/kg.

The Meeting estimated a maximum residue level of 1 mg/kg for thiabendazole in whole melons arising from pre-harvest application. The Meeting estimated a STMR value of 0.43 mg/kg and a HR value of 0.82 mg/kg for thiabendazole in whole melon, as information on the residue in the edible portion was not available.

Eight trials of a single post-harvest application of suspension concentrate formulations by spinning-disc spray were conducted on *potato* in the Netherlands in 1998. Four trials at 30 g ai/t were conducted according to the Dutch use pattern for this formulation (30 g ai/t; PHI, 60 days). For the remaining four trials (at 60 g ai/t), no Dutch use pattern was available, and the French use pattern (60 g ai/t; spray; no PHI specified) was used. The concentrations of residue in unpeeled tubers remained unchanged during storage up to 178 days. As the values in the trials at 30 and 60 g ai/t were not significantly different, the residues were treated as one group. The highest concentrations of residues in whole potato tubers were: 2.4, 3.2, 5.4, ***5.6***, ***7.9***, 8.0, 9.3, and 11 mg/kg.

In trials of post-harvest treatment of potatoes from the United Kingdom and the USA evaluated by the Meeting in 1997, the concentrations of residues of thiabendazole on unwashed potatoes were: 1.9, 2.0, 2.2, 2.4, ***2.6***, ***4.2***, 5.4, 5.5, 7.3, and 11 mg/kg.

Since the data sets evaluated in 1997 and by the present Meeting represent the same population, the Meeting decided to combine the two. The concentrations were: 1.9, 2.0, 2.2, 2.4 (2

trials), 2.6, 3.2, 4.2, 5.4 (2 trials), 5.5, 5.6, 7.3, 7.9, 8.0, 9.3, and 11 (2 trials) mg/kg. The Meeting confirmed the maximum residue level of 15 mg/kg for thiabendazole in whole potatoes proposed by the 1997 JMPR. The present Meeting established a STMR value of 5.4 mg/kg to replace the previous STMR value of 3.4 mg/kg and a HR value of 11 mg/kg.

Fate of residues during processing

Information was provided to the Meeting on the fate of thiabendazole during the processing of oranges, apples, and potatoes.

Washing removed 19–65% of the residue from *oranges*, and the remainder was concentrated in wet and dry pomace. The calculated mean processing factors in two trials of industrial processing of oranges were: 0.6 for washing, 0.08 for pasteurized juice, 0.3 for marmalade, *1.2* for wet pomace, and *5.7* for dry pomace.

The processing factors derived by the 1997 JMPR related to washed fruit, except those for marmalade made in a preserving pan (0.32) and in a microwave oven (0.37), which agree with that calculated by the present Meeting.

The median residue concentrations in processed commodities (STMR-P) calculated from the processing factors and the STMR value for unwashed whole citrus fruit (1.4 mg/kg) in supervised trials were: 0.08 ¥ 1.4 = 0.11 mg/kg for pasteurized orange juice; 0.3 ¥ 1.4 = 0.42 mg/kg for marmalade; 1.2 ¥ 1.4 = 1.7 mg/kg for wet orange pomace; and 5.7 ¥ 1.4 = 8.0 mg/kg for dry orange pomace.

Washing removed 20–42% of the residue from *apples*, and the residue was concentrated in dry pomace. The calculated industrial processing factors for *apples* were*: 0.68* for washing, 0.47 for pasteurized juice, 0.41 for apple sauce, 0.92 for wet pomace, and 4.2 for dry pomace.

The median residue concentrations in processed commodities (STMR-P) calculated from the processing factors and the STMR value for whole apples (1.7 mg/kg) were: 0.47 ¥ 1.7 = 0.8 mg/kg for pasteurized apple juice; 0.41 ¥ 1.7 = 0.7 mg/kg for apple sauce (puree); 0.92 ¥ 1.7 = 1.6 mg/kg for wet apple pomace; and 4.2 ¥ 1.7 = 7.1 mg/kg for dry apple pomace.

The Joint Meeting in 1997 discussed processing studies on potatoes extensively and noted that residues are transferred from the peel to the potatoes during peeling, as the average concentration was 1.54 mg/kg in potatoes peeled before washing and 0.08 mg/kg in those peeled after washing. Potatoes are always washed before peeling during industrial processing and either before or after peeling or both in the kitchen. In 1997, the Meeting therefore concluded that it was more appropriate to estimate the effect of peeling washed potatoes. By multiplying the STMR value derived in 1997 by the processing factors for both washing and peeling, the 1997 Meeting estimated a STMR-P value for washed peeled potatoes of 0.02 mg/kg and a STMR-P value of 0.44 mg/kg for washed potatoes.

The effects of frying, microwave and oven cooking, washing, boiling, baking, and crisping of potatoes treated with thiabendazole were also evaluated in 1997. That Meeting concluded that baking and frying did not change the residue content substantially. Furthermore, noting that baked potatoes may be consumed with or without the peel and fried potatoes may be prepared in a variety of ways, the 1997 Meeting recommended the use of STMR-P values for washed potatoes (0.44 mg/kg) and for washed peeled potatoes (0.02 mg/kg) for estimating dietary intake.

The present Meeting received the results of a new trial of the effects of washing, boiling, and frying of potatoes and the preparation of potato crisps. The calculated mean processing factors for

unwashed potatoes were: 0.08 for peeling, 0.27 for washing, 0.03 for peeling and washing, 0.09 for boiling, 0.07 for peeling after boiling, 0.29 for microwave boiling, 0.15 for peeling after microwave boiling, 0.01 for deep frying, and 0.00 for crisp processing. The mean of the processing factors for washing derived in 1997 and by the present Meeting was 0.2.

The Meeting agreed with the decision of the 1997 Meeting to use only the STMR-P values for washed and washed and peeled potatoes for estimating dietary intake. The median residue concentrations in processed commodities (STMR-P) calculated from the processing factors and the STMR value for unwashed whole potatoes (5.4 mg/kg) were: 1.08 mg/kg (0.2 ¥ 5.4) for washed potatoes and 0.16 mg/kg (0.03 ¥ 5.4) for washed peeled potatoes. These STMR-P values replace the previous recommendations. Furthermore, a STMR-P value for wet potato peel of 30 mg/kg (5.5 ¥ 5.4) is recommended for estimating animal dietary intake.

Residues in animal and poultry commodities

The Meeting estimated the dietary burden of thiabendazole residues in farm animals on the basis of the diets listed in Appendix IX of the *FAO Manual* (FAO, 1997). Calculation from MRLs (or HR values) provides concentrations in feed suitable for estimating MRLs for animal commodities, while calculation from STMR values for feed is suitable for estimating STMR values for animal commodities.

Commodity	HR (mg/kg)	Group	% dry matter	HR/dry matter	Percent of diet			Concentration of residue (mg/kg)		
					Beef cattle	Dairy cows	Poultry	Beef cattle	Dairy cows	Poultry
Wet apple pomace	1.8 (0.92 x 2.0)	AB	40	4.5	–	–	–	–	–	–
Dry citrus pulp	12.5 (5.7 x 2.2)	AB	91	13.7	20	20	–	2.74	2.74	–
Wet potato peel	60 (5.5 x 11)	SM	15	400	75	40	–	300	160	–
Total								303	163	–

Commodity	STMR (mg/kg)	Group	% dry matter	STMR/ dry matter	Percent of diet			Concentration of residue (mg/kg)		
					Beef cattle	Dairy cows	Poultry	Beef cattle	Dairy cows	Poultry
Wet apple pomace	1.6 (0.92 x1.7)	AB	40	4.0	–	–	–	–	–	–
Dry citrus pulp	8.0 (5.7 x 1.4)	AB	91	8.8	20	20	–	1.76	1.76	–
Wet potato peel	30 (5.5 x 5.4)	SM	15	200	75	40	–	150	80	–
Total								152	82	–

The dietary burdens of thiabendazole used for estimating MRLs and STMR values (residue concentrations in animal feeds expressed as dry weight) are 303 and 152 ppm for beef cattle and 163 and 82 ppm for dairy cows. Poultry are not exposed to thiabendazole residues. In the 28-day study evaluated by the 1997 JMPR in which dairy cows were fed diets containing 25, 75, or 250 ppm thiabendazole, the mean concentrations of thiabendazole and 5-hydroxythiabendazole residues on day 29 were 0.02 mg/kg in fat, 0.60 mg/kg in kidney, 0.21 mg/kg in liver, and 0.02 mg/kg in muscle at 250 ppm; and 0.03 mg/kg in fat, 0.27 mg/kg in kidney, 0.13 mg/kg in liver, and 0.02 mg/kg in muscle at 75 ppm. The highest concentration of thiabendazole plus 5-hydroxythiabendazole in milk reached on day

28 was 0.15 mg/kg at 250 ppm and 0.12 mg/kg at 75 ppm. The results with the lower dose indicated that a plateau had already been reached by day 28.

The residue definition for dietary intake of animal products is the sum of thiabendazole, 5-hydroxy-thiabendazole, and its sulfate conjugate. The sulfate conjugate is included since it is the main residue in milk. In the analytical method used for milk (Annex 6, reference 80, p. 791), the sulfate conjugate is presumed to be hydrolysed to 5-hydroxythiabendazole. The Meeting therefore estimated STMR values for cattle kidney, liver, meat, and milk on the basis of the feeding study evaluated by the 1997 Meeting.

The Meeting thus recommended withdrawal of the existing proposed MRLs and STMR values for cattle milk, meat, and edible offal. It estimated maximum residue levels of 1 mg/kg in cattle kidney, 0.3 mg/kg in cattle liver, 0.1 mg/kg in cattle meat, and 0.2 mg/kg in cows' milk, and STMR values of 0.5 mg/kg in cattle kidney, 0.2 mg/kg in cattle liver, 0.02 mg/kg in cattle meat, and 0.12 mg/kg in cows' milk.

At its thirty-second session, the CCPR requested (ALINORM 01/24, paragraph 104) the Joint Meeting to review the MRL for edible offal of cattle. It noted that the residue definition includes the sum of thiabendazole and 5-hydroxythiabendazole and considered that the MRL of 0.1 mg/kg might be too low.

The 1997 JMPR reviewed a study of transfer in ruminants within the periodic review of thiabendazole and recommended MRLs for cattle meat, milk, and offal. A MRL of 0.1 mg/kg was recommended for offal. At the recommended feeding level at that time of 25 ppm, the maximum concentrations of thiabendazole residues were 0.020 mg/kg in kidney and 0.049 mg/kg in liver. The LOQ of the analytical methods was reported to be 0.1 mg/kg for each analyte. Thus, the appropriate MRL would necessarily be 0.1 mg/kg plus 0.1 mg/kg or 0.2 mg/kg.

The manufacturer has now indicated that the LOQ of two methods for thiabendazole, benzimidazole, and 5-hydroxythiabendazole has been validated at 0.03 mg/kg. The combined LOQ would be 0.06 mg/kg, that is, 0.03 plus 0.03 mg/kg, on the basis of the Codex residue definition. The average recoveries of thiabendazole, benzimidazole, and 5-hydroxythiabendazole from cattle liver fortified at 0.03 mg/kg with each analyte were 90, 69, and 94%, respectively, and those from cattle kidney similarly fortified were 75, 105, and 65%, respectively (n = 6–8). The standard deviation for liver was excessive (17–23%).

The Meeting concluded that the proposed MRL of 0.1 mg/kg for the combined residue of thiabendazole and 5-hydroxythiabendazole, expressed as thiabendazole, in offal is appropriate, given the recent validations of the analytical method at 0.03 mg/kg for each analyte. However, in the light of the new data evaluated by the present Meeting (see above), the proposal is withdrawn and replaced by a recommendation for a maximum residue level of 1 mg/kg in cattle kidney and 0.3 mg/kg in cattle liver.

Dietary risk assessment

Chronic intake

STMR values have been estimated for 13 commodities, and the 1997 JMPR estimated STMR values for five additional commodities: bananas, mushrooms, poultry meat and eggs, and witloof chicory (sprouts).

The international estimated daily intakes from the five GEMS/Food regional diets, based on estimated STMR values, represented 1–9% of the ADI of 0–0.1 mg/kg bw. The Meeting concluded that long-term intake of residues of thiabendazole resulting from uses that have been considered by the JMPR is unlikely to present a public health concern.

Short-term intake

The toxicological profile of thiabendazole includes effects of concern that would indicate a need for an acute RfD. The Meeting recommended that this task be referred to JECFA, which conducted the most recent toxicological assessment of this chemical.

The IESTI for thiabendazole was calculated as described in Section 3 for the commodities for which maximum residue levels and STMR values were estimated and for which data on consumption were available. The results are shown in Annex 3. The IESTI varied from 0 to 0.287 mg/kg bw for the general population and from 0 to 0.939 mg/kg bw for children. As no acute RfD has been established yet, the risk assessment for thiabendazole was not finalized.

4.22 Thiodicarb (154)

Toxicological evaluation

Thiodicarb is a carbamate insecticide that acts by inhibiting acetylcholinesterase activity. It was last reviewed by the 1985 JMPR, when an ADI of 0–0.03 mg/kg bw was established. It was considered by the 2000 JMPR within the periodic review programme of the CCPR.

[acetimide-^{14}C]Thiodicarb was rapidly absorbed from the gastrointestinal tract of rats, monkeys *(Macaca fascicularis)*, goats, and cattle and was metabolized extensively to acetonitrile, CO_2, and polar components of low relative molecular mass. The initial step in metabolism involves hydrolysis to methomyl, which also inhibits acetylcholinesterase activity. The concentration of radiolabel after administration of [acetimide-^{14}C]thiodicarb at 2 mg/kg bw to rats reached a peak in plasma after 1 h, and it was excreted primarily as volatile components in exhaled air (40%) and urine (30%). The volatile compounds were identified as acetonitrile and CO_2. Urine contained predominantly (90%) components that could be extracted in aqueous solvents, although most of the radiolabel in rat urinary was not identified. The residues in the carcass 7 days after dosing represented 7–9% of the administered dose. Rat erythrocytes contained a large amount of unextractable radiolabel 7 days after dosing, and a similar result was found in hens. Similar patterns of metabolism were seen in rats, monkeys, goats, chickens, and cattle. Investigations in hens, goats, and cattle showed that the radiolabel was incorporated into biomolecules such as lipids, sugars, and egg shell.

In goats given capsules providing doses of 5–6 mg/kg bw per day (dietary equivalents of 200–300 ppm) for 7 days, the peak concentration of radioabel in milk was 15–20 ppm, with no individual component representing > 5 ppm. In cows dosed once at 7 mg/kg bw (equivalent to 330 ppm), the peak concentration in milk was 7 ppm. In edible tissues, the highest concentrations of radiolabel were found in liver (25 ppm in goats; 9 ppm in cows). A similar distribution of radiolabel was seen in cows given thiodicarb in the diet at concentrations up to 100 ppm for 21 days. In hens given [acetimide-^{14}C]thiodicarb at concentrations up to 100 ppm of diet for 21 days, the residues in edible tissues (up to 11 ppm in liver) and eggs (peak of 15 ppm in yolk) were present mainly as lipids or unextractable components, with < 1 ppm as acetonitrile or acetamide. Residues of thiodicarb, methomyl, or related carbamates or oximes were not detected in edible products of animals given [acetimide-^{14}C]thiodicarb, and the main residues identified were acetonitrile, acetamide, and acetic acid.

The LD_{50} values for orally administered thiodicarb were 50–100 mg/kg bw. Some studies showed that females were more susceptible than males. Thiodicarb was more toxic when administered orally in an aqueous vehicle than in corn oil. The toxicity of thiodicarb after inhalation varied considerably (LC_{50} values, 0.1–> 2.0 mg/l), depending on the study design used. Overall, it appeared to be moderately toxic when inhaled. It showed little toxicity when applied dermally, with LD_{50} values typically > 2000 mg/kg bw. It did not significantly irritate the skin or eyes. Weak responses were seen in studies of skin sensitization in guinea-pigs, but an extensive study in humans given patch tests showed no evidence of sensitization. The Meeting concluded that thiodicarb is unlikely to sensitize human skin. WHO has classified thiodicarb as moderately hazardous.

In studies in mammals treated by gavage, cholinergic toxicity was the primary effect. In rats, the time to peak inhibition of cholinesterase activity and effects in a battery of observational tests for function was less than 2 h, some effects first being seen at 0.5 h, with recovery within 24 h. A similar time-scale of effects was reported for inhibition of erythrocyte cholinesterase activity in dogs. These findings are consistent with the toxicokinetics of thiodicarb and of cholinesterase inhibition by carbamates in general, which show rapid reactivation. The Meeting considered that, in a number of studies with thiodicarb, the delay between the last exposure and sampling for erythrocyte or brain acetylcholinesterase activity (up to 48 h) was unacceptably long. Even in studies with repeated dietary doses in which attempts were made to minimize reactivation, thiodicarb often produced no consistent pattern of cholinesterase inhibition. Thiodicarb given in the diet to rodents did not produce cholinergic toxic effects, even at doses that caused significant cholinergic effects when administered by gavage. In studies with repeated doses and sequential measurements of erythrocyte cholinesterase activity over several months, there was no evidence of cumulative inhibition. In some studies, an adaptive increase in cholinesterase activity was seen.

The most extensive investigations of the cholinergic effects of thiodicarb are studies of neurotoxicity in rats given single or repeated doses. After a single dose by gavage, treatment-related effects were seen at 1 and 4 h but not at 24 h or subsequently. At a dose of 20 or 40 mg/kg bw, a range of effects was found in the a battery of observational tests for function and locomotor activity, with marked depression of cholinesterase activity (> 75%) in plasma, erythrocytes, and brain. At 5 mg/kg bw, the lowest dose tested, some signs of cholinergic effects were noted (pin-point pupils and reduced body temperature), with a significant depression (> 60%) of brain acetylcholinesterase activity. In a study in which rats received diets containing 0, 100, 400, or 800 ppm (equal to 6, 23, and 46 mg/kg bw per day) for 13 weeks, the only statistically significant findings were reductions in body-weight gain and food consumption at 400 and 800 ppm. The NOAEL was 100 ppm (equal to 6 mg/kg bw per day). No effects were observed on function or locomotor activity at any dose or time. As samples for determination of cholinesterase activity were not taken directly after feeding, some reactivation may have occurred. The lack of a clear decrease in brain acetylcholinesterase activity in animals receiving daily doses for 13 weeks that were nine times higher than the LOAEL of single dosing by gavage is probably due to the fact that spreading dietary intake over time led to a lower peak systemic concentration. No information was available on whether the bioavailability of thiodicarb residues in treated crops is reflected better by dietary or gavage treatment. In dogs treated in the diet, in which erythrocyte cholinesterase activity was determined about 2 h after dosing, significant inhibition was detected at 490 ppm (equal to 13 mg/kg bw per day), with a NOAEL of 160 ppm (equal to 4.5 mg/kg bw per day). The LOAELs for overt cholinergic effects (such as tremors) were 10 mg/kg bw per day in a study of developmental toxicity in rats treated by gavage, 20 mg/kg bw in a study of neurotoxicity in rats treated with a single dose by gavage, and 38 mg/kg bw per day in study of toxicity in dogs treated in the diet, with NOAELs of 1, 5, and 13 mg/kg bw per day, respectively.

Dermal exposure of rats to thiodicarb at a dose of 1000 mg/kg bw per day for 15 exposures over 3 weeks resulted in reduced (> 20%) brain acetylcholinesterase activity and alterations in

haematological parameters that were qualitatively consistent with those observed in animals exposed orally.

The principal non-cholinergic effects of thiodicarb were reduced body-weight gain and food consumption and altered erythrocyte parameters with associated splenic lesions. These changes were seen in all species tested (mice, rats, and dogs), with no clear indication that any species was especially sensitive. The reduced food consumption and body-weight gain were generally, but not always, related, and were more prevalent at the beginning of a study, possibly indicating a local effect or unpalatability rather than systemic toxicity. Reductions in erythrocyte count, haematocrit, and haemoglobin concentration, sometimes associated with increased mean cell volume and reticulocyte number, were seen after 90 days of exposure at 45 mg/kg bw per day in dogs or 150 mg/kg bw per day in rats. The LOAEL in rats exposed for 79 weeks was 12 mg/kg bw per day. Increased relative spleen weight was seen in rats given thiodicarb for 2 weeks at doses 120 mg/kg bw per day, which progressed with the duration of dosing, such that after 2 years' exposure at 12 mg/kg bw per day there was an increased incidence of splenic extramedullary haematopoiesis. The effects on the spleen (haemosiderosis, increased weight, and extramedullary haematopoiesis) were consistent with macrocytic anaemia and the resulting homeostatic response. The overall NOAEL for erythrocytic and splenic effects was 3 mg/kg bw per day. Evidence of liver hypertrophy was seen in mice given thiodicarb at doses 1800 ppm (equal to 350 mg/kg bw per day) for 4 weeks and in dogs receiving 90 mg/kg bw per day for 13 weeks or 45 mg/kg bw per day for 26 weeks; there was no consistent evidence of hepatotoxicity in rats. Occasional findings, such as fluctuations in potassium content (decreased in rats, increased in dogs) and alterations in urinary pH and volume, were not reproducible, were not associated with histopathological findings, and were considered to be of no significance for human risk assessment.

The carcinogenic potential of thiodicarb was investigated in two studies in mice and two studies in rats. In the first study in mice, the incidences of tumours were not increased at the highest dose tested (10 mg/kg bw per day), a dose which increased the mortality rate during some segments of the study. In the second study, mice received diets that provided doses up to 1000 mg/kg bw per day, which is more than 10 times the LD_{50} value after a single dose by gavage. Administration of the highest dose was associated with statistically significant increases in the incidences of hepatocellular carcinoma and adenoma. The incidence of hepatocellular adenoma in male mice receiving a dietary concentration equal to 70 mg/kg bw per day was increased (22%), and although not statistically significant it was marginally greater than the higher value of the range in historical controls (0–18%). This dose also increased the incidences of liver masses and hepatocellular pleiomorphism in males. Female mice given a dietary concentration equal to 70 mg/kg bw per day did not show increased incidences of neoplastic or non-neoplastic liver lesions. The NOAEL was 5 mg/kg bw per day. The Meeting concluded that the liver tumours were not relevant to human risk assessment, as the dose of 1000 mg/kg bw per day exceeded the maximum tolerated dose and the tumours occurred in an organ that showed significant non-neoplastic effects.

The first study of carcinogenicity in rats involved the Fischer 344 strain and a high dose equal to 10 mg/kg bw per day, and it was not clearly demonstrated that thiodicarb had been tested at the maximum tolerated dose. The only indication of tumorigenesis was a low incidence of thymomas (2%) in males receiving 10 mg/kg bw per day. The rate was greater than the value for concurrent controls, and the lesion was consistent with hyperplasia of lymphoid and epithelial cells of the thymus. However, the incidence of thymoma was not increased in females in this study nor in Sprague-Dawley rats of either sex. The NOAEL in the study with Fischer 344 rats was 3 mg/kg bw per day.

In the second study of carcinogenicity, Sprague-Dawley rats received diets containing thiodicarb at concentrations up to 900 ppm (equal to 60 mg/kg bw per day). The overall incidence of benign and malignant tumours was lower in animals at the highest dose than in controls even though

the survival rate was higher. The incidences of tumours in the liver and thymus were not increased. The incidence of thyroid C-cell carcinomas in males at the highest dose (2/50) was marginally greater than the upper bound of the range in historical controls (0–2%), but it was not statistically significant, was associated with a reduced incidence of C-cell adenomas, and was not reproduced in females. Males at the highest dose also had an increased incidence of interstitial-cell adenoma of the testis (12/50), which was greater than that in historical controls (0–10%), and was associated with an increased incidence of testicular atrophy. Interstitial-cell tumours are an age-related finding in rats, and the long survival of these animals may have contributed to the finding. A statistical analysis corrected for survival showed that the finding could have been due to chance (odds ratio, 2.9; 95% confidence interval, 0.9–9.4). The NOAEL for tumours was 200 ppm (equal to 12 mg/kg bw per day), and the overall NOAEL was 60 ppm (equal to 3 mg/kg bw per day). The Meeting concluded that there was no consistent evidence that thiodicarb has significant carcinogenic potential in rats.

An extensive range of studies has been performed for genotoxicity with thiodicarb, both *in vitro* and *in vivo*. Positive findings were reported at cytotoxic concentrations in an assay for gene mutation in mouse lymphoma L5178Y cells and over a range of concentrations in an assay for mitotic gene conversion in *Saccharomyces cerevisiae*. Negative results were seen in seven further studies *in vitro* and in three conducted *in vivo*. The Meeting concluded that thiodicarb is unlikely to be genotoxic *in vivo*.

In view of the lack of genotoxicity *in vivo* and the finding of significant increases in the incidence of tumours only in mice and only at concentrations that were clearly toxic, the Meeting concluded that thiodicarb is not likely to pose a carcinogenic risk to humans.

In studies of reproductive toxicity in rats, thiodicarb did not adversely affect mating performance or litter size at birth when given at doses up to 3000 ppm (equivalent to 180 mg/kg bw per day). In a three-generation study of reproductive toxicity, there were no effects on pup survival or development at the highest dose, equivalent to 10 mg/kg bw per day. In a single-generation range-finding study and a two-generation study, pup weights and survival to day 4 were consistently reduced at doses of 15 mg/kg bw per day and above. An increased frequency of pups found dead with no milk in the stomach was seen at doses 15 mg/kg bw per day, the cause of which was not determined. At 15 mg/kg bw per day, there was evidence of maternal toxicity, with a 10–15% deficit in body weight. Measurements of cholinesterase activities in 21-day old F_{2b} pups of dams exposed at 900 ppm (equal to 72 mg/kg bw per day) showed a statistically nonsignificant degree of inhibition, which was not seen in the parents or in other generations. The overall NOAEL in the three studies of reproductive toxicity was 10 mg/kg bw per day.

Thiodicarb was tested for developmental toxicity in mice, rats, and rabbits at doses up to 200, 100, and 40 mg/kg bw per day, respectively, all of which induced death or marked toxicity in dams. The LOAEL for maternal toxicity in the most sensitive species, rats, was 10 mg/kg bw per day, with a NOAEL of 1 mg/kg bw per day. Delayed ossification and reduced fetal weight were seen in one study of developmental toxicity in rats at maternally toxic doses of 10 mg/kg bw per day, but not in mice or rabbits or in two other studies in rats. The Meeting concluded that thiodicarb is not teratogenic.

The Meeting concluded that the existing database on thiodicarb is adequate to characterize the potential hazard to fetuses, infants, and children. Although thiodicarb is known to be neurotoxic in adults, the Meeting did not recommend that a study of developmental neurotoxicity be conducted since there was no clear evidence that offspring are more sensitive after pre- or postnatal exposure than adults in the same experiment.

As is to be expected of a carbamate, thiodicarb did not induce delayed neuropathy in hens administered a single dose of 660 mg/kg bw.

No studies have been performed in which thiodicarb was given orally to volunteers. Routine medical monitoring of persons working in thiodicarb manufacture and formulation revealed no adverse effects attributable to exposure to thiodicarb during 20 years of production.

The Meeting maintained the previously established ADI of 0–0.03 mg/kg bw, as it considered that it was still appropriate for use as a basis for assessing the risks associated with long-term intake. This conclusion was based on the NOAEL of 3 mg/kg bw per day for effects on erythrocytes and splenic haemosiderosis or extramedullary haematopoiesis in long-term studies of toxicity and carcinogenicity in rats and a safety factor of 100.

The Meeting concluded that the toxicological profile of thiodicarb requires establishment of an acute RfD and that the most appropriate end-points are cholinergic signs and inhibition of acetylcholinesterase activity. The Meeting established an acute RfD of 0.04 mg/kg bw for thiodicarb by applying a safety factor of 25 to the NOAEL of 1 mg/kg bw per day for clinical signs in the study of developmental toxicity in rats treated by gavage. A 25-fold safety factor was used because the data on thiodicarb indicate that the cholinergic effects are associated with the peak systemic concentration, and there is evidence that effects related to peak concentrations vary less between species and within populations than those related to a product of concentration and time (for additional details, see Annex 5). The acute RfD is supported by the NOAEL of 4.5 mg/kg bw per day for erythrocyte acetylcholinesterase activity in dogs 2 h after dosing and provides a margin of 125 on the LOAEL of 5 mg/kg bw per day for inhibition of acetylcholinesterase activity and related findings in the study of neurotoxicity in rats treated with a single dose by gavage.

A toxicological monograph was prepared, summarizing the data received since the previous evaluation and including relevant data from previous monographs and monograph addenda.

Levels relevant to risk assessment

Species	Study	Effect	NOAEL	LOAEL
Mouse	2-year studies of toxicity	Toxicity and carcinogenicity[a,b]	5 mg/kg bw per day Carcinogenicity	10mg/kg bw per day 70 mg/kg bw per day
	1000 mg/kg bw per day[c]			
	Developmental toxicity[d]	Maternal toxicity	100 mg/kg bw per day	200 mg/kg bw per day
	–	Embryo- and fetotoxicity	200 mg/kg bw per day	200 mg/kg bw per day
Rat	2 year studies of toxicity	Toxicity	60 ppm, equal to 3 mg/kg bw per day	60 ppm, equal to 5 mg/kg bw per day (52 weeks)
	and carcinogenicity[a]	Carcinogenicity	900 ppm, equal to 60 mg/kg bw per day[e]	–
	Multi-generation study of reproductive toxicity[a,b]	Maternal and pup toxicity	10 mg/kg bw per day	300 ppm, equivalent to 15 mg/kg bw per day
	Developmental toxicity[d]	Maternal toxicity Embryo- and fetotoxicity	1 mg/kg bw per day 100 mg/kg bw per day[e]	10 mg/kg bw per day –

Species	Study	Effect	NOAEL	LOAEL
Rat (contd)	Acute neurotoxicity[d]		–	5 mg/kg bw[f]
Rabbit	Developmental toxicity[d]	Maternal toxicity Embryo- and fetotoxicity	20 mg/kg bw per day 40 mg/kg bw per day[e]	40 mg/kg bw per day –

Dog	1-year study of toxicity[a] 13 mg/kg bw per day	Toxicity	160 ppm, equivalent to	490 ppm, equivalent to 4.5 mg/kg bw per day

[a] Dietary administration
[b] Two or more studies combined
[c] Greater than the maximum tolerated dose
[d] Gavage
[e] Highest dose tested
[f] Lowest dose tested

Estimate of acceptable daily intake for humans

0–0.03 mg/kg bw

Estimate of acute reference dose

0.04 mg/kg bw

Studies that would provide information valuable for continued evaluation of the compound

Further observations in humans

Summary of critical end-points

Absorption, distribution, excretion and metabolism in mammals	
Rate and extent of oral absorption	Rapid (60% within 15 min) and extensive (> 70%)
Distribution	Extensive; highest concentration in erythrocytes
Potential for accumulation	Low, with the exception of erythrocytes
Rate and extent of excretion	Rapid (mainly in 0–12-h samples) and extensive; significant proportion as exhaled volatiles
Metabolism in animals	Very extensive, primary excretion as acetonitrile and CO_2; retained radiolabel may be associated with simple carbon compounds incorporated into biomolecules
Toxicologically significant compounds	Thiodicarb and methomyl
Acute toxicity	
Rats, LD_{50}, oral	50–100 mg/kg bw (depending on vehicle)
Rats, LD_{50}, intraperitoneal	No data
Mice, LD_{50}, oral	75 mg/kg bw
Skin sensitization (test method used)	Negative or weak response in guinea-pigs (Buehler); negative in human patch test
Short-term toxicity	
Target/critical effect	Cholinesterase inhibition, effects on erythrocytes (mild macrocytic anaemia) and associated splenic findings
Lowest relevant oral NOAEL	4.5 mg/kg bw per day (52 weeks, dogs)
Genotoxicity	Negative *in vivo*
Long-term toxicity and carcinogenicity	
Target/critical effect	Macrocytic anaemia, splenic effects (haemosiderin deposition, extramedullary haematopoiesis); liver hyperplasia in mice
Lowest relevant NOAEL	3 mg/kg bw per day (rats)
Carcinogenicity	Liver tumours in mice at toxic doses; clear NOAELs identified Unlikely to pose a risk to humans
Reproductive toxicity	

Reproduction target/critical effect	Reduced pup viability and weight
Lowest relevant reproductive NOAEL	10 mg/kg bw per day (rats)
Developmental target/critical effect	Not teratogenic; no specific embryo- or fetotoxicity
Lowest relevant developmental NOAEL	> 40 mg/kg bw per day (rabbits)
Neurotoxicity	
Acute	< 5 mg/kg bw; cholinesterase inhibition; no neuropathy
90 days	6 mg/kg bw per day; no neuropathy
Delayed neuropathy	None
Medical data	No adverse effects in production workers

Summary	***Value***	***Study***	***Safety factor***
ADI	0–0.03 mg/kg bw	Rat, repeated doses	100
Acute RfD	0.04 mg/kg bw	Rat, developmental and maternal toxicity	25

Dietary risk assessment

Because the residue definition of thiodicarb includes methomyl, the dietary intake assessment of thiodicarb was postponed to 2001, when methomyl will be re-evaluated.

5. RECOMMENDATIONS

5.1 In the interests of public health and agriculture and in view of the needs of the Codex Committee on Pesticide Residues, the Meeting *recommended* that Joint Meetings on Pesticide Residues should continue to be held annually.

5.2 The Meeting *recommended* (Section 2.1) that the method for calculating the International Estimate of Short-term Dietary Intake (IESTI) be improved as the Meeting gains experience in applying it.

5.3 The Meeting *recommended* (Section 2.3) that GEMs/Foods should provide more data on consumption of processed commodites, such as apple juice.

5.4 The Meeting *recommended* (Section 2.4) that a case-by-case approach be used in establishing residue definitions for pesticides used on both genetically modified and non-transgenic crops.

5.5 The Meeting *recommended* (Section 2.5) that further consideration be given to minimum data requirements when the OECD documents have been finalized.

5.6 The Meeting *recommended* (Section 2.6) that, from next year, the JMPR base its recommendations for MRLs on current uses only and that new and amended uses be recommended only at such time that those uses become GAP.

5.7 The Meeting *recommended* (Section 2.7) that FAO/WHO take appropriate action to increase the transparency of the process whereby they select experts and to ensure the excellence and independence of the scientists, by developing ethical guidelines to take account of all real, potential, or apparent conflicts of interest.

5.8 The Meeting *recommended* (Section 2.9) that statistical calculations should be used where relevant in estimating maximum residue levels, and further *recommended* that the situation be re-examined when more practical experience has been gained in the use of statistical methods on the readily available residue populations produced by the STMR procedure.

5.9 The Meeting *recommended* (Section 2.9) that full summary information on GAP be supplied for the evaluation of a compound, but that the original labels need be provided only for those uses that are adequately supported by data on residues.

5.10 The Meeting *recommended* (Section 2.9) that acute RfD values should be considered for all compounds.

5.11 The Meeting noted the difficulty that arises when compounds reviewed for both toxicology and residues have metabolites of toxicological concern with ADIs different from that of the parent compound.

6. FUTURE WORK

The items listed below should be considered by the Meeting in 2001 and 2002. The compounds listed include those recommended as priorities by the CCPR at its thirty-second or earlier sessions and compounds scheduled for re-evaluation within the CCPR Periodic Review Programme.

6.1 2001 Meeting (tentative)

Toxicological evaluations

New compounds

imidacloprid
spinosad

Periodic review

carbaryl (008)
lindane (048)
methoprene (147)
prochloraz (142)

Other evaluations

diazinon (022)
diflubenzuron (130)
imazalil (110)
methomyl (094)
phosalone (060)

Residue evaluations

New compounds

chlorpropham
fipronil
spinosad

Periodic review

carbaryl (008)
diflubenzuron(130)
dimethipin(151)
diphenylamine (030)
imazalil (110)
methomyl(094)
thiodicarb(154)
propargite (113)
piperonyl butoxide (062)

Other Evaluations

aldicarb (117)
haloxyfop (194)
kresoxim-methyl (199)
iprodione (111)
tebufenozide (196)

6.2 2002 Meeting (tentative)

Toxicological evaluations

New compounds

esfenvalerate[1]
flutolanil

Periodic review

acephate (095)
metalaxyl-M[2]
methamidophos (100)
oxamyl (126)
paraquat (057)
tolylfluanid (162)
triazophos (143)

Other evaluations

carbofuran (096)
ethephon (106)
guazatine (114)
fenpropimorph

Residue evaluations

New compounds

esfenvalerate[1]
imidacloprid
flutolanil

Periodic review

acephate (095)
deltamethrin (135)
methamidophos (100)
oxamyl (126)
paraquat (057)
pirimiphos-methyl (086)
procloraz (142)
triazophos (143)

Other Evaluations

carbofuran (096)
dithiocarbamates (105)
guazatine (114)
malathion (049)
myclobutanil (181)
phosmet (103)

[1] Replacement for fenvalerate
[2] Replacement for metalaxyl

ANNEX 1

ACUTE DIETARY INTAKES, ACUTE REFERENCE DOSES, RECOMMENDED MAXIMUM RESIDUE LIMITS, AND SUPERVISED TRIALS MEDIAN RESIDUE VALUES RECORDED BY THE 2000 MEETING

The table below lists maximum ADIs, acute RfDs, recommended MRLs, and STMR and HR levels. The application of the HR levels is explained in the report of the 1999 Meeting (Annex 6, reference 86, Section 2.4). The PTDI and ERLs for DDT are given in a separate table. The rationale of the PTDI is explained in the report of the 1994 Meeting (Annex 6, reference 71, Section 2.3). Pesticides for which the estimated dietary intake might, on the basis of the available information, exceed their ADIs are marked with footnotes as explained in detail in the report of the 1999 Meeting (Section 2.2). Footnotes are also applied to specific commodities in which the acute RfD of a pesticide might be exceeded if the food commodity when consumed. These distinctions apply only to new compounds and to those re-evaluated within the CCPR periodic review programme.

STMR levels were introduced in 1996 in response to recommendations of a Joint FAO/WHO Consultation on Guidelines for Predicting the Dietary Intake of Pesticide Residues held in York, United Kingdom, in 1995. The report of the 1996 Meeting (Annex 6, reference 77) explains the reasons for their introduction and gives details of the procedures used in their calculation.

In general, the MRLs recommended for compounds that have been reviewed previously are additional to, or amend, those recorded in the reports of earlier Meetings. If a recommended MRL is an amendment, the previous value is also recorded. All recommendations for compounds re-evaluated within the CCPR periodic review programme are listed, however (even if identical to existing Codex or draft MRLs), because such re-evaluations replace the original evaluation rather than supplement it.

Temporary ADIs are indicated by the letter T, and the year in which re-evaluation is scheduled is given in parentheses below the ADI. All recommended MRLs for compounds with temporary ADIs are necessarily temporary, but other recommendations are designated as temporary (TMRLs) until the required information has been provided and evaluated, irrespective of the status of the ADI.

The table includes the Codex reference number of each compound and the Codex classification number (CCN) of each commodity, to facilitate reference to the Codex maximum limits for Pesticide Residues (*Codex Alimentarius*, Vol. 2B) and other documents and working documents of the Codex Alimentarius Commission.

The abbreviations and symbols used in the table and not defined elsewhere are as follows:

*	at or about the limit of quantification
N	new compound
Po	accommodates post-harvest treatment of the commodity
PoP	accommodates post-harvest treatment of the primary food commodity (classes D and E in the Codex classification)
R	reviewed within CCPR periodic review programme
T	temporary
V	accommodates veterinary uses
W	The previous recommendation is withdrawn, or withdrawal of the recommended MRL or existing Codex or draft MRL is recommended.

Pesticide	ADI (mg/kg bw)	Commodity		Recommended MRL (mg/kg)		STMR (mg/kg)	HR (mg/kg)
		CCN	Name	New	Previous		
Abamectin (177)	0.002	MO 1281	Cattle liver	0.1	0.1		
		MF 0812	Cattle fat	0.1	0.1		
		MO 1289	Cattle kidney	0.05	0.05		
		MM 0812	Cattle meat	0.01*	0.01*		
		ML 0812	Cattle milk	0.005	0.005		
		MO 0814	Goat edible offal	0.1	0.1		
		MM 0814	Goat meat	0.01*	0.01*		
		ML 0814	Goat milk	0.005	0.005		
		Residue For compliance with MRL for plant commodities: sum of avermectin B_{1a} , avermectin B_{1b}, 8,9-*Z*-avermectin B_{1a}, and 8,9-*Z*-avermectin B_{1b} For compliance with MRL for animal commodities: sum of avermectin B_{1a} and 8,9-*Z*-avermectin B_{1a} For estimation of dietary intake: sum of avermectin B_{1a}, avermectin B_{1b}, 8,9-*Z*-avermectin B_{1a}, and 8,9-Z-avermectin B_{1b} *Note*: The numerical values for the recommended MRLs remain unchanged, but the residue definition is revised.					
Captan (007) (R)	0.1	TN 0660	Almonds	0.3	–	0.05	0.2
		FP 0226	Apple	W	20	–	–
		AB 0226	Apple pomace, dry	W	2	4.95	7.8
		FB 0020	Blueberries	20	20	6.9	18
		FS 0013	Cherries	25	40	11	21
		VC 0424	Cucumber	3	–	0.22	1.5
		DF 0269	Dried grapes (currants, raisins and sultanas)	50	50	5.6	33
		FB 0269	Grapes	25	25	3.7	22
		VC 0046	Melons, except watermelon	10	–	0.04	0.13
		FS 0245	Nectarine	3	5	1.0	1.8
		FS 0247	Peach	20	15	4.7	16
		FP 0230	Pear	W	10	–	–
		FS 0014	Plums (including prunes)	10	5	1.4	7.9
		FP0009	Pome fruits	15 Po	–	5.3	11
		VR 0589	Potato	0.05	–	0.05	0.05
		DF 0014	Prunes			0.15	0.84
		FB 0272	Raspberries, red, black	20	–	8.3	18
		FB 0275	Strawberry	15	30	4.15	12
		VO 0448	Tomato	5	2	0.64	2.3
		VJ 0448	Tomato juice			0.06	0.23
			Tomato puree			0.06	0.23
		Residue For compliance with MRL and estimation of dietary intake: captan Acute RfD: Unnecessary Periodic review for residues only					
Chlormequat (015) (R)	0.05	GC 0640	Barley	2	0.5	0.15	1.8
			Barley beer			0.0023	
			Barley malt			0.1	
			Barley pearl			0.009	
		AS 0640	Barley straw and fodder, dry	W	20		
		PE 0112	Eggs	0.1	–	0.04	0.064
		MM 0814	Goat meat	0.2	–	0.04	0.11

Pesticide	ADI (mg/kg bw)	Commodity CCN	Name	Recommended MRL (mg/kg) New	Previous	STMR (mg/kg)	HR (mg/kg)
Chlormequat (contd)		MO 0098	Kidney of cattle, goats, pigs, and sheep	0.5	–	0.084	0.35
		MO 0099	Liver of cattle, goats, pigs, and sheep	0.1	–	0.042	0.88
		AS 0645	Maize fodder	7[1]	–	2.3[1]	
		AF 0645	Maize forage	15[1]	–	6.5[1]	
		MM 0097	Meat of cattle, pigs, and sheep	0.2	–	0.04	0.11
		ML 0107	Milk of cattle, goats, and sheep	0.5	–	0.018	0.35
		GC 0647	Oats	10	10	1.2	7.1
			Oat flakes			0.25	
		AF 0647	Oat forage, green	100[1]	20	12.7[1]	
		AS 0647	Oat straw and fodder, dry	W	20		
		FP 0230	Pear[2]	10	10	4.2	6.3
		PM 0110	Poultry meat	0.04*	–	0	0
		PO 0111	Poultry, edible offal of	0.1	–	0.0096	0.053
		SO 0495	Rape-seed			2.05	
		OC 0495	Rape-seed oil, crude			0.037	
		GC 0650	Rye	3	3	0.26	2
		CM 0650	Rye bran, unprocessed	10	10	0.83	
		CF 1250	Rye flour	3	–	0.26	
		AF 0650	Rye forage (green)	100[1]	20	12.7[1]	
		AF 0650	Rye straw and fodder, dry	W	20		
		CF 1251	Rye wholemeal	4	3	0.34	
			Rye wholemeal bread			0.25	
		AS 0081	Straw and fodder (dry) of cereal grains		30[1]	–	4.2[1]
		GC 0653	Triticale	3	–	0.26	2
		GC 0654	Wheat	3	2	0.26	2
		CM 0654	Wheat bran, unprocessed	10	5	0.94	
		CF 1211	Wheat flour	2	0.5	0.11	
		AS 0654	Wheat straw and fodder, dry	W	20		
		CF 1212	Wheat wholemeal	5	2	0.31	
			Wheat wholemeal bread			0.18	
		Residue For compliance with MRL and for estimation of dietary intake: Chlormequat cation (usually used as the chloride) [1] Expressed on dry weight basis [2] The information provided to the JMPR precludes an estimate that the dietary intake would be below the acute RfD. Acute RfD: 0.05 mg/kg bw					
Chlorpropham (N)	0.03	Acute RfD: 0.03 mg/kg bw					
Chlorpyrifos (017) (R)	0.01	AL 1020	Alfalfa fodder (hay)	5	–	0.81	
		AL 1021	Alfalfa forage (green)	20	–	1.2	
		TN 0660	Almonds	0.05	–	0.05	0.05
			Almond, hulls		–	2.3	3.2
		FP 0226	Apple	W[1]	1		
		JF 0226	Apple juice			0.027	
		AB 0226	Apple pomace, dry		–	1.2	6.2
			Apple pomace, wet			0.34	1.9
		FI 0327	Banana	2	–	0.01	0.05
		VB 0400	Broccoli	2	–	0.02	1.4
		VB 0041	Cabbages, head	1	0.05*	0.15	0.94
		VR 0577	Carrot	0.1	0.5	0.025	0.05

Pesticide	ADI (mg/kg bw)	Commodity		Recommended MRL (mg/kg)		STMR (mg/kg)	HR (mg/kg)
		CCN	Name	New	Previous		
Chlorpyrifos (contd)		MO 1280	Cattle, kidney	0.01		0.01	0.01
		MO 1281	Cattle, liver	0.01		0.01	0.01
		MM 0812	Cattle meat	1 (fat)	2 (fat)V	0.02	0.02
		VB 0404	Cauliflower	0.05	0.05*	0.01	0.02
		VS 0624	Celery	W	0.05*		
		VL 0467	Chinese cabbage (type pe-tsai)	1	1	0.18	0.60
		FC 0001	Citrus fruits	2	2	0.08	0.4
		JF 0001	Citrus juice		–	0.007	
			Citrus oil		–	2.2	11
		AB 0001	Citrus pulp, dry		–	0.72	3.6
		SB 0716	Coffee	0.05		0.010	0.014
		VP 0526	Common bean (pods and/or immature seeds)	0.01	0.2	0.01	0.01
		SO 0691	Cottonseed	W	0.05*		
		OC 0691	Cottonseed oil, crude	W	0.05*		
		DF 0269	Dried grapes (currants, raisins, and sultanas)	0.1	2	0.017	0.07
		VO 0440	Eggplant	W	0.2		
		PE 0112	Eggs	0.01*	0.05*	0.001	0.01
		FB 0269	Grapes	0.5	1	0.085	0.32
		JF 0269	Grape juice		–	0.005	
			Grapes, wine		–	0.007	
		VL 0480	KaleW	1			
		FI 0341	Kiwifruit	W	2		
		VL 0482	Lettuce, head	W	0.1		
		GC 0645	Maize	0.05	–	0.015	
		AF 0645	Maize forage	20	–	8.2	
		AS 0645	Maize fodder	10	–	2.8	
			Maize, milled by-products		–	0.02	0.09
		OR 0645	Maize oil, edible	0.2	–	0.03	
		CF 0645	Maize meal		–	0.01	
		ML 0106	Milks	W	0.01*		
		ML 0107	Milk of cattle, goats, and sheep	0.02		0.005	
		VO 0450	Mushrooms	W	0.05*		
		VA 0385	Onion, bulb	0.2	0.05*	0.04	0.08
		VP 0063	Peas (pods and succulent immature seeds)	0.01		0.01	0.01
		AL 0528	Pea vines, green	1		0.10	
		FS 0247	Peach	0.5	–	0.042	0.33
		FP 0230	PearW[1]	0.5			
		TN 0672	Pecan	0.05*	–	0.05	0.05
		VO 0051	Peppers	W	0.5		
		VO 0445	Peppers, sweet	2		0.38	1.4
		FS 0014	Plums (including prunes)	0.5	–	0.04	0.20
		MO 0818	Pigs, edible offal of	0.01*		0.00	0.01
		MM 0818	Pig meat	0.02 (fat)		0.001	0.01
		FP 0009	Pome fruits	1	–	0.17	0.94
		VR 0589	Potato	W	0.05*		
		PM 0110	Poultry meat	0.01 (fat)	0.1 (fat)	0.001	0.01
		PO 0111	Poultry, edible offal of	0.01*		0.00	0.01
		FB 0272	Raspberries, red, black	W	0.2	– –	
		GC 0649	RiceW	0.1			
		MO 0822	Sheep, edible offal of	0.01		0.01	0.01
		MM 0822	Sheep meat	1 (fat)	0.2 (fat)V	0.02	0.02

Pesticide	ADI (mg/kg bw)	Commodity CCN	Name	Recommended MRL (mg/kg) New	Previous	STMR (mg/kg)	HR (mg/kg)
Chlorpyrifos (contd)		GC 0651	Sorghum	0.5	–	0.04	
		AS 0651	Sorghum straw and fodder, dry	2	–	0.29	
			Sorghum, flour		–	0.008	
		FB 0275	Strawberry	0.3	–	0.09	0.15
		VR 0596	Sugar beet	0.05	0.05*	0.015	0.03
			Sugar beet, top	40	–	3.0	
		VO 0447	Sweet corn	0.01*		0.01	0.01
		VO 0448	Tomato	0.5	0.5	0.13	0.33
		JF 0448	Tomato, juice		–	0.026	
			Tomato, paste		–	0.026	
		PM 0848	Turkey meat	W	0.2 fat (V)		
		TN 0678	Walnuts	0.05*	–	0.05	0.05
		GC 0654	Wheat	0.5	–	0.015	
		AS 0654	Wheat straw and fodder, dry	5	–	0.54	
			Wheat, milled by–products		–	0.03	0.75
		CF 1211	Wheat flour	0.1	–	0.002	
		CM 0654	Wheat bran, unprocessed			0.03	
			Wheat shorts			0.03	
		Residue For compliance with MRL and estimation of dietary intake:chlorpyrifos The residue is fat-soluble. Acute RfD: 0.1 mg/kg bw Periodic review for residues only [1]Replaced by recommendation for pome fruit					
Deltamethrin (135) (R)	0. 01	Acute RfD: 0.05 mg/kg bw ADI unchanged Periodic review for toxicology only					
Dinocap (087)[1]	0.008	Acute RfD:0.008 mg/kg bw (for women of childbearing age); 0.03 mg/kg bw (for children and for the general population other than women of childbearing age) [1] The information provided to the JMPR precludes an estimate that the acute dietary intake from the consumption of grape by women of childbearing age would be below the acute RfD					
Dodine (084) (R)	0.1	Acute RfD: 0.2 mg/kg bw Previous ADI: 0.01 mg/kg bw Periodic review for toxicology only					
Fenitrothion (037) (R)	0.005	Acute RfD: 0.04 mg/kg ADI unchanged Periodic review for toxicology only					
Fenthion (039)[1]	0.007	*Residue* For compliance with MRL and estimation of dietary intake: sum of fenthion, its oxygen analogue and their sulfoxides and sulfones, expressed as fenthion The residue is fat-soluble. Acute RfD: 0.01 mg/kg bw [1] The 1995 recommendation to withdraw the MRL for meat (of mammals other than marine mammals) and milks is confirmed.					

Pesticide	ADI (mg/kg bw)	Commodity CCN	Name	Recommended MRL (mg/kg) New	Previous	STMR (mg/kg)	HR (mg/kg)
Fipronil	0.0002	Acute RfD: 0.003 mg/kg bw (for fipronil and fipronil-desulfinyl, alone or in combination) ADI: group ADI for fipronil and fipronil-desulfinyl					
Imazalil (110) (R)	0.03	Acute RfD: Unnecessary ADI unchanged Periodic review for toxicology only					
Malathion (049)	0.3	CF 1211	Wheat flour	0.2	2 PoP	0.0092	
		CF 1212	Wheat wholemeal	W	2 PoP		
		CM 0654	Wheat bran, unprocessed	W	20 PoP		
		Residue For compliance with MRL and estimation of dietary intake): malathion Acute RfD: may be necessary but not yet established					
Mevinphos (053)	0.0008	VB 0400	Broccoli	W	W		
		FC 0001	Citrus fruits	W	W		
		VC 0424	Cucumber	W	W		
		FB 0269	Grapes	W	W		
		VC 0046	Melons, except watermelon	W	W		
		VP 0063	Peas (pods and succulent immature seeds)	W	W		
		VL 0502	Spinach	W	W		
		FB 0275	Strawberry	W	W		
		VO 0506	Tomato	W	W		
		Residue For compliance with MRL and for estimation of dietary intake: sum of (*E*)- and (*Z*)-mevinphos Acute RfD: 0.003 mg/kg bw					
Parathion (58) (R)	0.004	FP 0226	Apple [1]	0.2	0.05*	0.025	0.16
		JF 0226	Apple juice			0.0018	
		AB 0226	Apple pomace, dry			0.078	0.62
		FS 0240	Apricot	W	1		
		GC 0640	Barley [2]	7		1.95	5.1
		AS 0640	Barley straw and fodder, dry	30		7.75	
		SO 0691	Cottonseed	3	1	0.35	2.1
		VA 0384	Leek	W	0.05		
		FC 0204	Lemon	W	0.5		
		GC 0645	Maize	0.1	0.1	0.05	0.09
		CF1255	Maize flour	0.1		0.034	
		AS 0645	Maize fodder	30		2.13	
		AF 0645	Maize forage	10		2.28	
			Maize grits			0.05	
		CF 0645	Maize meal			0.037	0.074
			Maize starch			0.014	
		OC 0645	Maize oil, crude	0.3		0.12	
		OR 0645	Maize oil, edible	0.3		0.12	
		FC 0206	Mandarin	W	0.5		
		OC 0305	Olive oil, virgin	W	2		
		FT 0305	Olives	W	0.5		
		FC 0004	Oranges, sweet, sour	W	0.5		
		FS 0247	Peach	W	1		
		VR 0589	Potato	W	0.05*		
		GC 0652	Sorghum	5	5	1.06	4.2
			Sorghum bran			2.0	
			Sorghum flour			0.42	

Pesticide	ADI (mg/kg bw)	Commodity		Recommended MRL (mg/kg)		STMR (mg/kg)	HR (mg/kg)
		CCN	Name	New	Previous		
Parathion (contd)			Sorghum grits			0.49	
			Sorghum starch			0.016	
		AF 0651	Sorghum forage, green	10		3.1	
		AS 0651	Sorghum straw and fodder, dry	15		2.8	
		VD 0541	Soya bean, dry	0.05*	0.05*	0.05	0.05
		AL 0541	Soya bean fodder	2		0.63	
		SO 0702	Sunflower seed	0.05*	0.05*	0.05	0.05
			Sunflower seed meal			0.0025	0.0025
		OR 0702	Sunflower seed oil, edible	0.05*		0.021	
		VO 0447	Sweet corn	0.05*		0.05	0.05
		GC 0654	Wheat	1		0.125	0.96
		CM 0654	Wheat bran, unprocessed			0.58	
		CF 1211	Wheat flour			0.044	
			Wheat shorts (animal feed)			0.10	0.80
		AS 0654	Wheat straw and fodder, dry	20		3.7	
		Residue					
		For compliance with MRLs: parathion					
		For estimation of dietary intake: Sum of parathion and paraoxon expressed as parathion.					
		Acute RfD: 0.01 mg/kg bw					
		Periodic review for residues only					
		[1]The information provided to the JMPR precludes an estimate that the acute dietary intake of children would be below the acute reference dose					
		[2]The information provided to the JMPR precludes an estimate that the acute dietary intake of the general population would be below the acute reference dose					
Parathion-methyl (59) (R)	0.003	AL 1020	Alfalfa fodder	70		2.3	
		AL 1021	Alfalfa forage (green)	70		3.7	
		FP 0226	Apple	0.2		0.06	0.18
		JF 0226	Apple juice			0.015	
		AB 0226	Apple pomace, dry			0.31	1.04
		VS 0620	Artichoke globe	W	2		
		AL 1030	Bean forage, green, fresh weight	1	1	0.11	
		VD 0071	Bean (dry)	0.05*	0.05*	0.05	0.05
		VB 0400	Broccoli	W	0.2		
		VB 0041	Cabbages, head	0.05	0.2	0.05	0.26
		VR 0577	Carrot	W	1		
		VS 0624	Celery	W	5		
		FS 0013	Cherries	W	0.01*		
		AL 1023	Clover	W	10		
		VP 0526	Common bean (pods and/or immature seeds)	W	0.05*		
		SO 0691	Cottonseed	25		3.5	22
			Cottonseed hulls			1.54	9.7
			Cottonseed meal			0.28	2.00
		OC 0691	Cottonseed oil, crude	10		1.54	
		OR 0691	Cottonseed oil, edible	10		1.16	
		DF 0269	Dried grapes (currants, raisins and sultanas)	1		0.14	0.70
		VP 0528	Garden pea (young pods)	W	1		
		FB 0268	Gooseberry	W	0.01*		
		JF 0269	Grape juice			0.0006	
		FB 0269	Grapes	0.5		0.10	0.41
		AS 0162	Hay or fodder (dry) of grasses	5	5	0.68	
		DH 1100	Hops, dry	W	1		

Pesticide	ADI (mg/kg bw)	Commodity		Recommended MRL (mg/kg)		STMR (mg/kg)	HR (mg/kg)
		CCN	Name	New	Previous		
Parathion-methyl (contd)		VL 0482	Lettuce, head	W	0.05*		
		VL 0483	Lettuce, leaf	W	0.5		
		VP 0534	Lima bean (young pods and/or immature beans)	W	0.05*		
		GC 0645	Maize	0.1		0.05	0.09
		CF 1255	Maize flour	0.05		0.021	
			Maize grits			0.019	
			Maize meal			0.023	0.046
		OC 0645	Maize oil, crude	0.2		0.067	
		OR 0645	Maize oil, edible	0.1		0.051	
			Maize starch			0.0045	
		VL 0485	Mustard greens	W	0.5		
		AL 0072	Pea hay or pea fodder, dry	70		5.5	
		AL 0528	Pea vines, green	40		0.74	
		FS 0247	Peach	0.3		0.095	0.22
			Peach juice			0.031	
		VD 0072	Peas, dry	0.3	0.2	0.06	0.24
		FS 0014	Plums (including prunes)	W	0.01*		
		VR 0589	Potato	0.05*	0.05*	0	0
		SO 0495	Rape seed	0.05		0.05	0.05
			Rape seed meal			0.011	0.011
		OC 0495	Rape-seed oil, crude	0.2		0.12	
		OR 0495	Rape-seed oil, edible	0.2		0.10	
		FB 0272	Raspberries, red, black	W	0.01*		
		GC 0649	Rice	W	3		
		AS 0649	Rice straw and fodder, dry	W	10		
		CM 0649	Rice, husked	W	1		
		VL 0502	Spinach	W	0.5		
		VR 0596	Sugar beet	0.05*	0.05*	0	0
		AV 0596	Sugar beet leaves or tops (fresh weight)	0.05*	0.05*	0.05	
		VL 0506	Turnip greens	W	2		
		VR 0506	Turnip, garden	W	0.05*		
		GC 0654	Wheat	5	5	0.29	4.1
		CM 0654	Wheat bran, unprocessed	10	10	0.64	
		CF 1211	Wheat flour	2		0.11	
		AS 0654	Wheat straw and fodder, dry	10	10	1.03	
			Wine			0.0015	
		Residue For compliance with MRL: parathion-methyl. For estimation of dietary intake: Sum of parathion-methyl and paraoxon- methyl expressed as parathion-methyl Acute RfD: 0.03 mg/kg bw Periodic review for residues only					
Pyrethrins (063) (R)	0.04	GC 0080	Cereal grains	W	3Po		
		FC 0001	Citrus fruit	0.05		0.04	0.04
		JF 0001	Citrus juice			0.026	
		DM 001	Citrus molasses			0.0276	0.276
		AB 001	Citrus fruit, dry			0.342	0.342
			Citrus oil			0.812	0.812
		MD 0180	Dried fish	W	3Po		
		DF 0167	Dried fruit	0.2Po	1Po	0.05	0.11
		DV 0168	Dried vegetables	W	1Po		
Pyrethrins (contd)		VC 0045	Fruiting vegetables, curcubits	0.05*		0.04	0.04
		SO 0088	Oilseed	W	1Po		
		AL 0072	Pea hay, dry	1		0.295	
		AL 0528	Pea vine, dry	10		2.15	
		SO 0697	Peanut	0.5 Po		0.05	0.23
		VO 0051	Peppers	0.05*		0.04	0.04
		VD 0070	Pulses	0.1		0.05	0.05

Pesticide	ADI (mg/kg bw)	Commodity CCN	Name	Recommended MRL (mg/kg) New	Previous	STMR (mg/kg)	HR (mg/kg)
		VR 0075	Root and tuber vegetables	0.05*		0	0.04
		VO 0448	Tomato	0.05*		0.04	0.04
			Tomato pomace, dry			0.808	0.808
			Tomato pomace, wet			0.352	0.352
		VJ 0448	Tomato, juice			0.018	
			Tomato, puree			0.018	
		TN 0085	Tree nuts	W	1Po		
		Residue					
		For compliance with MRL and estimation of dietary intake: total pyrethrins, calculated as the sum of pyrethrins 1 and 2, cinerins 1 and 2, and jasmolins 1 and 2, determined after calibration with the World Standard pyrethrum extract					
		Acute RfD: 0.2 mg/kg bw					
		Periodic review for residues only					
Pyriproxifen (200)	0.1		Orange oil			9.0	
		AB 0001	Citrus pulp, dry			0.76	6.3
		JF 0004	Orange juice			0.0036	
		Residue					
		For compliance with MRL and for estimation of dietary intake): pyriproxyfen					
		The residue is fat-soluble.					
		Acute RfD: Unnecesssary					
Thiabendazole (065)	0.1	FP 0226	Apple	W[1]	W		
			Apple juice			0.8	
			Apple pomace, dry			7.1	
			Apple pomace, wet			1.6	
			Apple puree			0.7	
		FI 0326	Avocado	15 Po	–	0.9	1.8
		FC 0001	Citrus fruits	3 Po	W	0.01	0.09
		ML 0812	Cattle milk	0.2	0.05	0.12	0.15
		ML 0812	Cattle meat	0.1	0.05	0.02	0.02
		MO 0812	Cattle, edible offal of	w	0.1		
		MO 1280	Cattle, kidney	1		0.5	0.6
		MO 1281	Cattle, liver	0.3		0.2	0.21
		FI 0345	Mango	5 Po	–	2.85	4.6
		VC 0046	Melon, except watermelon	1	–	0.43	0.82
		FI 0350	Papaya	10 Po	–	3.8	5.1
		FP 0230	Pear	W[1]	W		
		FP 0009	Pome fruits	3 Po	–	1.7	2.0
		VR 0589	Potato	15 Po	15	5.4	11
			Potato, washed			1.08	
			Potato, washed and peeled			0.16	
			Potato peel, wet			30	
		FB 0275	Strawberry	5	W	1.6	2.7
			Orange pomace, dry			8	
			Orange pomace, wet			1.7	
			Orange juice			0.11	
		Residue					
		For compliance with MRL and estimation of dietary intake for plant commodities: thiabendazole					
		For compliance with MRL for animal commodities: sum of thiabendazole and 5-hydroxythiabendazole					
		For estimation of dietary intake for animal commodities: sum of thiabendazole, 5-hydroxythiabendazole and its sulfate conjugate					
		ADI established at the forty-eighth meeting of the Joint FAO/WHO Expert Committee on Food Additives (WHO Technical Report Series No. 879, 1998).					
		Acute RfD: May be necessary but not yet established					
		[1]Replaced by recommendation for pome fruit					

Pesticide	ADI (mg/kg bw)	Commodity		Recommended MRL (mg/kg)		STMR (mg/kg)	HR (mg/kg)
		CCN	Name	New	Previous		
Thiodicarb (154) (R)	0.03	Acute RfD: 0.04 mg/kg bw Periodic review for toxicology only ADI unchanged					

Provisional tolerable daily intake and extraneous residue limits for DDT

PTDI (mg/kg bw)	Commodity		ERL (mg/kg)	
	CCN	Name	New[a]	Previous
0.01	MM 0095	Meat (from mammals other than marine mammals)	1–5 (fat)	5 (fat)[b]
	PM 0110	Poultry meat	0.1–0.3 (fat)	–
	Acute RfD: Unnecessary			

[a] The Meeting estimated the total concentrations of DDT corresponding to violation rates of 0.1%, 0.2%, and 0.5% for mammalian and poultry meat according to the procedure described in Section 4.7 of this Report. The Meeting concluded that the selection of an acceptable violation rate and the weight given to the information provided by individual countries are risk management issues, not scientific ones. The CCPR should decide which violation rate is acceptable and whether each contributing country or each analysed sample should be given the same weight. Therefore, the table shows a range of values for ERLs. For dietary intake calculations, the worst case assumption, the highest ERLs of 5 mg/kg for mammalian meat and 0.3 mg/kg for poultry meat, were used. This resulted in intake well below the PTDI.

[b] Recommendation of the 1996 JMPR

ANNEX 2

INDEX OF REPORTS AND EVALUATIONS OF PESTICIDES BY THE JMPR

Numbers in parentheses after the names of pesticides are Codex classification numbers. The abbreviations used are:

T, evaluation of toxicology
R, evaluation of residue and analytical aspects
E, evaluation of effects on the environment

Bromomethane (052)	1965 (T,R), 1966 (T,R), 1967 (R), 1968 (T,R), 1971 (R), 1979 (R), 1985 (R), 1992 (R)
Bromophos (004)	1972 (T,R), 1975 (R), 1977 (T,R), 1982 (R), 1984 (R), 1985 (R)
Bromophos-ethyl (005)	1972 (T,R), 1975 (T,R), 1977 (R)
Bromopropylate (070)	1973 (T,R), 1993 (T,R)
Butocarboxim (139)	1983 (R), 1984 (T), 1985 (T), 1986 (R)
Buprofezin (173)	1991 (T,R), 1995 (R), 1996 (corr. to 1995 report.), 1999 (R)
sec-Butylamine (089)	1975 (T,R), 1977 (R), 1978 (T,R), 1979 (R), 1980 (R), 1981 (T), 1984 (T,R: withdrawal of temporary ADI, but no evaluation)
Cadusafos (174)	1991 (T,R), 1992 (R), 1992 (R)
Campheclor (071)	1968 (T,R), 1973 (T,R)
Captafol (006)	1969 (T,R), 1973 (T,R), 1974 (R), 1976 (R), 1977 (T,R), 1982 (T), 1985 (T,R), 1986 (corr. to 1985 report), 1990 (R), 1999 (acute Rf D)
Captan (007)	1965 (T), 1969 (T,R), 1973 (T), 1974 (R), 1977 (T,R), 1978 (T,R), 1980 (R), 1982 (T), 1984 (T,R), 1986 (R), 1987 (R and corr. to 1986 R evaluation), 1990 (T,R), 1991 (corr. to 1990 R evaluation), 1994 (R), 1995 (T), 1997 (R), 2000 (R)
Carbaryl (008)	1965 (T), 1966 (T,R), 1967 (T,R), 1968 (R), 1969 (T,R), 1970 (R), 1973 (T,R), 1975 (R), 1976 (R), 1977 (R), 1979 (R), 1984 (R), 1996 (T)
Carbendazim (072)	1973 (T,R), 1976 (R), 1977 (T), 1978 (R), 1983 (T,R), 1985 (T,R), 1987 (R), 1988 (R), 1990 (R), 1994 (R), 1995 (T,E), 1998 (T,R)
Carbofuran (096)	1976 (T,R), 1979 (T,R), 1980 (T), 1982 (T), 1991 (R), 1993 (R), 1996 (T), 1997 (R), 1999 (corr. to 1997 report)
Carbon disulfide (009)	1965 (T,R), 1967 (R), 1968 (R), 1971 (R), 1985 (R)
Carbon tetrachloride (010)	1965 (T,R), 1967 (R), 1968 (T,R), 1971 (R), 1979 (R), 1985 (R)
Carbophenothion (011)	1972 (T,R), 1976 (T,R), 1977 (T,R), 1979 (T,R), 1980 (T,R), 1983 (R)
Carbosulfan (145)	1984 (T,R), 1986 (T), 1991 (R), 1992 (corr. to 1991 report), 1993 (R), 1997 (R), 1999 (R)
Cartap (097)	1976 (T,R), 1978 (T,R), 1995 (T,R)
Chinomethionat (080)	1968 (T,R) (as oxythioquinox), 1974 (T,R), 1977 (T,R), 1981 (T,R), 1983 (R), 1984 (T,R), 1987 (T)
Chlorbenside	1965 (T)
Chlordane (012)	1965 (T), 1967 (T,R), 1969 (R), 1970 (T,R), 1972 (R), 1974 (R), 1977 (T,R), 1982 (T), 1984 (T,R), 1986 (T)
Chlordimeform (013)	1971 (T,R), 1975 (T,R), 1977 (T), 1978 (T,R), 1979(T), 1980(T), 1985(T), 1986 (R), 1987 (T)
Chlorfenson	1965 (T)
Chlorfenvinphos (014)	1971 (T,R), 1984 (R), 1994 (T), 1996 (R)
Chlormequat (015)	1970 (T,R), 1972 (T,R), 1976 (R), 1985 (R), 1994 (T,R), 1997 (T), 1999 (acute Rf D), 2000 (R)
Chlorobenzilate (016)	1965 (T), 1968 (T,R), 1972 (R), 1975 (R), 1977 (R), 1980 (T)
Chloropicrin	1965 (T,R)

Chloropropylate	1968 (T,R), 1972 (R)
Chlorothalonil (081)	1974 (T,R), 1977 (T,R), 1978 (R), 1979 (T,R), 1981 (T,R), 1983 (T,R), 1984 (corr. to 1983 report and T evaluation), 1985 (T,R), 1987 (T), 1988 (R), 1990 (T,R), 1991 (corr. to 1990 evaluation), 1992 (T), 1993 (R), 1997 (R)
Chlorpropham	1965 (T), 2000 (T)
Chlorpyrifos (017)	1972 (T,R), 1974 (R), 1975 (R), 1977 (T,R), 1981 (R), 1982 (T,R), 1983 (R), 1989 (R), 1995 (R), 1999 (T), 2000 (R)
Chlorpyrifos-methyl (090)	1975 (T,R), 1976 (R, Annex I only), 1979 (R), 1990 (R), 1991 (T,R), 1992 (T and corr. to 1991 report), 1993 (R), 1994 (R)
Chlorthion	1965 (T)
Clethodim (187)	1994 (T,R), 1997 (R), 1999 (R)
Clofentezine (156)	1986 (T,R), 1987 (R), 1989 (R), 1990 (R), 1992 (R)
Coumaphos (018)	1968 (T,R), 1972 (R), 1975 (R), 1978 (R), 1980 (T,R), 1983 (R), 1987 (T), 1990 (T,R)
Crufomate (019)	1968 (T,R), 1972 (R)
Cyanophenfos (091)	1975 (T,R), 1978 (T: ADI extended, but no evaluation), 1980, (T), 1982 (R), 1983 (T)
Cycloxydim (179)	1992 (T,R), 1993 (R)
Cyfluthrin (157)	1986 (R), 1987 (T and corr. to 1986 report), 1989 (R), 1990 (R), 1992 (R)
Cyhalothrin (146)	1984 (T,R), 1986 (R), 1988 (R)
Cyhexatin (tricyclohexyltin hydroxide) (067)	1970 (T,R), 1973 (T,R), 1974 (R), 1975 (R), 1977 (T), 1978 (T,R), 1980 (T), 1981 (T), 1982 (R), 1983 (R), 1985 (R), 1988 (T), 1989 (T), 1991 (T,R), 1992 (R), 1994 (T)
Cypermethrin (118)	1979 (T,R), 1981 (T,R), 1982 (R), 1983 (R), 1984 (R), 1985 (R), 1986 (R), 1987 (corr. to 1986 evaluation), 1988 (R), 1990 (R)
Cyromazine (169)	1990 (T,R), 1991 (corr. to 1990 R evaluation), 1992 (R)
2,4-D (020)	1970 (T,R), 1971 (T,R), 1974 (T,R), 1975 (T,R), 1980 (R), 1985, (R), 1986 (R), 1987 (corr. to 1986 report, Annex I), 1996 (T), 1997 (E), 1998 (R)
Daminozide (104)	1977 (T,R), 1983 (T), 1989 (T,R), 1991 (T)
DDT (021)	1965 (T), 1966 (T,R), 1967 (T,R),1968 (T,R), 1969 (T,R), 1978 (R), 1979 (T), 1980 (T), 1983 (T), 1984 (T), 1993 (R), 1994 (R), 1996 (R)
Deltamethrin (135)	1980 (T,R), 1981 (T,R), 1982 (T,R), 1984 (R), 1985 (R), 1986 (R), 1987 (R), 1988 (R), 1990 (R), 1992 (R), 2000 (T)
Demeton (092)	1965 (T), 1967 (R), 1975 (R), 1982 (T)
Demeton-*S*-methyl (073)	1973 (T,R), 1979 (R), 1982 (T), 1984 (T,R), 1989 (T,R), 1992 (R), 1998 (R)
Demeton-*S*-methylsulphon (164)	1973 (T,R), 1982 (T), 1984 (T,R), 1989 (T,R), 1992 (R)
Dialifos (098)	1976 (T,R), 1982 (T), 1985 (R)

Diazinon (022)	1965 (T), 1966 (T), 1967 (R), 1968 (T,R), 1970 (T,R), 1975 (R), 1979 (R), 1993 (T,R), 1994 (R), 1996 (R), 1999 (R)
1,2-Dibromoethane (023)	1965 (T,R), 1966 (T,R), 1967 (R), 1968 (R), 1971 (R), 1979 (R), 1985 (R)
Dichlorfluanid (082)	1969 (T,R), 1974 (T,R), 1977 (T,R), 1979 (T,R), 1981 (R),1982 (R), 1983 (T,R), 1985 (R)
1,2-Dichloroethane (024)	1965 (T,R), 1967 (R), 1971 (R), 1979 (R), 1985 (R)
Dichlorvos (025)	1965 (T,R), 1966 (T,R), 1967 (T,R), 1969 (R), 1970 (T,R), 1974 (R), 1977 (T), 1993 (T,R)
Dicloran (083)	1974 (T,R), 1977 (T,R), 1998 (T,R)
Dicofol (026)	1968 (T,R), 1970 (R), 1974 (R), 1992 (T,R), 1994 (R)
Dieldrin (001)	1965 (T), 1966 (T,R), 1967 (T,R), 1968 (R), 1969 (R), 1970, (T,R), 1974 (R), 1975 (R), 1977 (T), 1990 (R), 1992 (R)
Diflubenzuron (130)	1981 (T,R), 1983 (R), 1984 (T,R), 1985 (T,R), 1988 (R)
Dimethipin (151)	1985 (T,R), 1987 (T,R), 1988 (T,R), 1999 (T)
Dimethoate (027)	1965 (T), 1966 (T), 1967 (T,R), 1970 (R), 1973 (R in evaluation of formothion), 1977 (R), 1978 (R), 1983 (R) 1984 (T,R) 1986 (R), 1987 (T,R), 1988 (R), 1990 (R), 1991 (corr. to 1990 evaluation), 1994 (R), 1996 (T), 1998 (R)
Dimethrin	1965 (T)
Dinocap (087)	1969 (T,R), 1974 (T,R), 1989 (T,R), 1992 (R), 1998 (R), 1999 (R), 2000 (T)
Dioxathion (028)	1968 (T,R), 1972 (R)
Diphenyl (029)	1966 (T,R), 1967 (T)
Diphenylamine (030)	1969 (T,R), 1976 (T,R), 1979 (R), 1982 (T), 1984 (T,R), 1998 (T)
Diquat (031)	1970 (T,R), 1972 (T,R), 1976 (R), 1977 (T,R), 1978 (R), 1994 (R)
Disulfoton (074)	1973 (T,R), 1975 (T,R), 1979 (R), 1981 (R), 1984 (R), 1991 (T,R), 1992 (corr. to 1991 report, Annex I), 1994 (R), 1996 (T), 1998 (R)
Dithianon (180)	1992 (T,R), 1995 (R), 1996 (corr. to 1995 report)
Dithiocarbamates (105)	1965 (T), 1967 (T,R), 1970 (T,R), 1983 (R propineb, thiram), 1984 (R propineb), 1985 (R), 1987 (T thiram), 1988 (R thiram), 1990 (R), 1991 (corr. to 1990 evaluation), 1992 (T thiram), 1993 (T,R), 1995 (R), 1996 (T,R ferbam, ziram;, R thiram)
4,6-Dinitro-*ortho*-cresol (DNOC)	1965 (T)
Dodine (084)	1974 (T,R), 1976 (T,R), 1977 (R), 2000 (T)
Edifenphos (099)	1976 (T,R), 1979 (T,R), 1981 (T,R)
Endosulfan (032)	1965 (T), 1967 (T,R), 1968 (T,R), 1971 (R), 1974 (R), 1975 (R), 1982 (T), 1985 (T,R), 1989 (T,R), 1993 (R), 1998 (T)
Endrin (033)	1965 (T), 1970 (T,R), 1974 (R), 1975 (R), 1990 (R), 1992 (R)

Glufosinate-ammonium (175)	1991 (T,R), 1992 (corr. to 1991 report, Annex I), 1994 (R), 1998 (R), 1999 (T,R)GLYPHOSATE (158) 1986 (T,R), 1987 (R and corr. to 1986 report), 1988 (R), 1994 (R), 1997 (T,R)
Guazatine (114)	1978 (T.R), 1980 (R), 1997 (T,R)
Haloxyfop (194)	1995 (T,R), 1996 (R and corr. to 1995 report)
Heptachlor (043)	1965 (T), 1966 (T,R), 1967 (R), 1968 (R), 1969 (R), 1970 (T,R), 1974 (R), 1975 (R), 1977 (R), 1987 (R), 1991 (T,R), 1992 (corr. to 1991 report, Annex I), 1993 (R), 1994 (R)
Hexachlorobenzene (044)	1969 (T,R), 1973 (T,R), 1974 (T,R), 1978(T), 1985 (R)
Hexaconazole (170)	1990 (T,R), 1991 (R and corr. to 1990 R evaluation), 1993 (R)
Hexythiazox (176)	1991 (T,R), 1994 (R), 1998 (R)
Hydrogen cyanide (045)	1965 (T,R)
Hydrogen phosphide (046)	1965 (T,R), 1966 (T,R), 1967 (R), 1969 (R), 1971 (R)
Imazalil (110)	1977 (T,R), 1980 (T,R), 1984 (T,R), 1985 (T,R), 1986 (T), 1988 (R), 1989 (R), 1991 (T), 1994 (R), 2000 (T)
Iprodione (111)	1977 (T,R), 1980 (R), 1992 (T), 1994 (R), 1995 (T)
Isofenphos (131)	1981 (T,R), 1982 (T,R), 1984 (R), 1985 (R), 1986 (T,R), 1988 (R), 1992 (R)
Kresoxim-methyl (199)	1998 (T,R)
Lead arsenate	1965 (T), 1968 (T,R)
Leptophos (088)	1974 (T,R), 1975 (T,R), 1978 (T,R)
Lindane (048)	1965 (T), 1966 (T,R), 1967 (R), 1968 (R), 1969 (R), 1970 (T,R, published as Annex VI to 1971 evaluations), 1973 (T,R), 1974 (R), 1975 (R), 1977 (T,R), 1978 (R), 1979 (R), 1989 (T,R), 1997 (T)
Malathion (049)	1965 (T), 1966 (T,R), 1967 (corr. to 1966 R evaluation), 1968 (R), 1969 (R), 1970 (R), 1973 (R), 1975 (R), 1977 (R), 1984 (R), 1997 (T), 1999 (R), 2000 (R)
Maleic hydrazide (102)	1976 (T,R), 1977 (T,R), 1980 (T), 1984 (T,R), 1996 (T), 1998 (R)
Mancozeb (050)	1967 (T,R), 1970 (T,R), 1974 (R), 1977 (R), 1980 (T,R), 1993 (T,R)
Maneb	See Dithiocarbamates, 1965 (T), 1967 (T,R), 1987 (T), 1993 (T,R)
Mecarbam (124)	1980 (T,R), 1983 (T,R), 1985 (T,R), 1986 (T,R), 1987 (R)
Metalaxyl (138)	1982 (T,R), 1984 (R), 1985 (R), 1986 (R), 1987 (R), 1989 (R), 1990 (R), 1992 (R), 1995 (R)
Methacrifos (125)	1980 (T,R), 1982 (T), 1986 (T), 1988 (T), 1990 (T,R), 1992 (R)
Methamidifos (100)	1976 (T,R), 1979 (R), 1981 (R), 1982 (T,R[2]), 1984 (R), 1985 (T), 1989 (R), 1990 (T,R), 1994 (R), 1996 (R), 1997 (R)

Phosmet (103)	1976 (R), 1977 (corr. to 1976 R evaluation), 1978 (T,R), 1979 (T,R), 1981 (R), 1984 (R), 1985 (R), 1986 (R), 1987 (R and corr. to 1986 R evaluation), 1988 (R), 1994 (T), 1997 (R), 1998 (T)
Phosphine	See Hydrogen phosphide
Phosphamidon (061)	1965 (T), 1966 (T), 1968 (T,R), 1969 (R), 1972 (R), 1974 (R), 1982 (T), 1985 (T), 1986 (T)
Phoxim (141)	1982 (T), 1983 (R), 1984 (T,R), 1986 (R), 1987 (R), 1988 (R)
Piperonyl butoxide (062)	1965 (T,R), 1966 (T,R), 1967 (R), 1969 (R), 1972 (T,R), 1992 (T,R), 1995 (T)
Pirimicarb (101)	1976 (T,R), 1978 (T,R), 1979 (R), 1981 (T,R), 1982 (T), 1985 (R)
Pirimiphos-methyl (086)	1974 (T,R), 1976 (T,R), 1977 (R), 1979 (R), 1983 (R), 1985 (R), 1992 (T), 1994 (R)
Prochloraz (142)	1983 (T,R), 1985 (R), 1987 (R), 1988 (R), 1989 (R), 1990 (R), 1991 (corr. to 1990 report, Annex I, and R evaluation), 1992 (R)
Procymidone(136)	1981 (R), 1982 (T), 1989 (T,R), 1990 (R), 1991 (corr. to 1990 Annex I), 1993 (R), 1998 (R)
Profenofos (171)	1990 (T,R), 1992 (R), 1994 (R), 1995 (R)
Propamocarb (148)	1984 (T,R), 1986 (T,R), 1987 (R)
Propargite (113)	1977 (T,R), 1978 (R), 1979 (R), 1980 (T,R), 1982 (T,R), 1999 (T)
Propham (183)	1965 (T), 1992 (T,R)
Propiconazole (160)	1987 (T,R), 1991 (R), 1994 (R)
Propineb	1977 (T,R), 1980 (T), 1983 (T), 1984 (R), 1985 (T,R), 1993 (T,R)
Propoxur (075)	1973 (T,R), 1977 (R), 1981 (R), 1983 (R), 1989 (T), 1991 (R), 1996 (R)
Propylenethiourea (PTU, 150)	1993 (T,R), 1994 (R), 1999 (T)
Pyrazophos (153)	1985 (T,R), 1987 (R), 1992 (T,R), 1993 (R)
Pyrethrins (063)	1965 (T), 1966 (T,R), 1967 (R), 1968 (R), 1969 (R), 1970 (T), 1972 (T,R), 1974 (R), 1999 (T), 2000 (R)
Pyriproxyfen	1999 (R,T), 2000 (R)
Quintozene (064)	1969 (T,R) 1973 (T,R), 1974 (R), 1975 (T,R), 1976 (Annex I, corr. to 1975 R evaluation), 1977 (T,R), 1995 (T,R), 1998 (R)
2,4,5-T (121)	1970 (T,R), 1979 (T,R), 1981 (T)
Tebuconazole (189)	1994 (T,R), 1996 (corr. to Annex II of 1995 report), 1997 (R)
Tebufenozide (196)	1996 (T,R), 1997 (R), 1999 (R)
Tecnazine (115)	1974 (T,R), 1978 (T,R), 1981 (R), 1983 (T), 1987 (R), 1989 (R), 1994 (T,R)
Teflubenzuron (190)	1994 (T), 1996 (R)
Terbufos (167)	1989 (T,R), 1990 (T,R)
Thianedazole (065)	1970 (T,R), 1971 (R), 1972 (R), 1975 (R), 1977 (T,R), 1979 (R), 1981 (R), 1997 (R), 2000 (R)
Thiodicarb (154)	1985 (T,R), 1986 (T), 1987 (R), 1988 (R), 2000 (T)
Thiometon (076)	1969 (T,R), 1973 (T,R), 1976 (R), 1979 (T,R), 1988 (R)

Annex 3
DIETARY INTAKE OF PESTICIDES IN RELATION TO ADIs

The followong Tables give details of the estimated daily intakes of the pesticides evaluated by the meeting for the five GEMS/Food regional diets, and and show the ratios of the estimated intakes to the corresponding ADIs

(*) at or about the LOQ
The ranges of the intake/ADI ratios for all the compounds evaluated are tabulated in Section 3.

CAPTAN (7) **INTERNATIONAL ESTIMATED DAILY INTAKE (IEDI)**

ADI = 0.1 mg/kg bodyweight or 6 mg/person

Commodity		MRL	STMR	Process-ing		Adjusted	Middle Eastern		Far Eastern		African		Latin American		European	
						STMR	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	mg/kg	factor	Notes	mg/kg	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
TN 0660	Almonds	0,3	0,05				0,5	0,0000	0,0	0,0000	0,0	0,0000	0,1	0,0000	1,8	0,0001
FB 0020	Blueberries	20	6,9				0,0	0,0000	0,0	0,0000	0,0	0,0000	0,0	0,0000	0,5	0,0035
FS 0013	Cherries	25	11				0,0	0,0000	0,0	0,0000	0,0	0,0000	0,0	0,0000	3,0	0,0330
VC 0424	Cucumber	3	0,22				4,8	0,0010	4,5	0,0010	0,0	0,0000	8,3	0,0018	9,0	0,0020
DF 0269	Dried grapes (= Currants,	50	5,6				0,3	0,0014	0,0	0,0000	0,0	0,0000	0,3	0,0014	2,3	0,0126
	Raisins and Sultanas)															
FB 0269	Grapes	25	3,7				15,5	0,0574	1,0	0,0037	0,0	0,0000	1,0	0,0037	11,5	0,0426
VC 0046	Melons except Watermelon	10	0,13	0,3	1/	0,04	16,0	0,0006	2,0	0,0001	0,0	0,0000	2,8	0,0001	18,3	0,0007
FS 0245	Nectarine	3	1,0				1,3	0,0013	0,3	0,0003	0,0	0,0000	0,4	0,0004	6,3	0,0063
FS 0247	Peach	20	4,7				1,3	0,0059	0,3	0,0012	0,0	0,0000	0,4	0,0018	6,2	0,0291
FS 0014	Plums (including prunes)	10	1,4				1,8	0,0025	0,5	0,0007	0,0	0,0000	0,0	0,0000	4,3	0,0060
FP 0009	Pome fruits	15	5,3		Po		10,8	0,0570	7,5	0,0398	0,3	0,0013	6,5	0,0345	51,3	0,2719
DF 0014	Prunes		0,15				0,0	0,0000	0,0	0,0000	0,0	0,0000	0,0	0,0000	0,5	0,0001
VR 0589	Potato	0,05	0,05				59,0	0,0030	19,2	0,0010	20,6	0,0010	40,8	0,0020	240,8	0,0120
FB 0272	Raspberries, Red, Black	20	8,3				0,0	0,0000	0,0	0,0000	0,0	0,0000	0,0	0,0000	0,5	0,0042
FB 0275	Strawberry	15	4,15				0,0	0,0000	0,0	0,0000	0,0	0,0000	0,0	0,0000	5,3	0,0218
VO 0448	Tomato	5	0,64				80,9	0,0518	7,0	0,0045	16,5	0,0106	25,5	0,0163	62,0	0,0397
VJ 0448	Tomato juice, single strength			0,1		0,06	0,3	0,0000	0,0	0,0000	0,0	0,0000	0,0	0,0000	2,0	0,0001
	Tomato puree			0,1		0,06	0,3	0,0000	0,0	0,0000	0,0	0,0000	0,0	0,0000	2,0	0,0001
	1/ Based on peeling						TOTAL =	0,1818		0,0521		0,0129		0,0620		0,4857
							% ADI =	3%		1%		0%		1%		8%

CHLORMEQUAT (15) INTERNATIONAL ESTIMATED DAILY INTAKE (IEDI)

ADI = 0.05 mg/kg body weight or 3 mg/person

Commodity				Process-ing factor		Adjusted	Middle Eastern		Far Eastern		African		Latin American		European	
		MRL	STMR			STMR	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	mg/kg		Notes	mg/kg	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
GC 0640	Barley	2	0,15				1	0,0002	3,5	0,0005	1,8	0,0003	6,5	0,001	19,8	0,003
PE 0112	Eggs	0,1	0,04				14,6	0,0006	13,1	0,0005	3,7	0,0001	11,9	0,0005	37,6	0,0015
MM 0814	Goat meat	0,2	0,04				2	0,0001	0,7	0	2,3	0,0001	0,8	0	0,3	0
MO 0098	Kidney of cattle/goats/pigs/sheep	0,5	0,084				1,4	0,0001	0,4	0	0,9	0,0001	2	0,0002	4,1	0,0003
MO 0099	Liver of cattle/goats/pigs/sheep	0,1	0,042				2,7	0,0001	0,9	0	1,8	0,0001	4	0,0002	8,2	0,0003
MM 0097	Meat of cattle, pigs and sheep	0,2	0,04				32	0,0013	31,3	0,0013	15	0,0006	43,5	0,0017	149,3	0,006
ML 0107	Milks of cattle, goats & sheep	0,5	0,018				114,5	0,0021	32	0,0006	41,3	0,0007	160	0,0029	294	0,0053
GC 0647	Oats	10	1,2				0	0	0	0	0,2	0,0002	0,8	0,0009	2	0,0024
FP 0230	Pear	10	4,2				3,3	0,0137	2,8	0,0119	0	0	1	0,0042	11,3	0,0473
PM 0110	Poultry meat	0,04*	0				31	0	13,2	0	5,5	0	25,3	0	53	0
PO 0111	Poultry, Edible offal of	0,1	0,0096				0,1	0	0,1	0	0,1	0	0,4	0	0,4	0
OC 0495	Rape seed oil, crude			0,18		0,037	4,5	0,0002	2,7	0,0001	0	0	0,3	0	7,3	0,0003
CF 1250	Rye flour	3		0,99		0,26	0	0	1	0,0003	0	0	0	0	1,5	0,0004
CM 0650	Rye bran, unprocessed	10		3,2		0,83	0	0	0	0	0	0	0	0	0	0
CF 1251	Rye wholemeal	4		1,3		0,34	0	0	1	0,0003	0	0	0	0	1,5	0,0005
GC 0653	Triticale	3	0,26				0	0	1	0,0003	0	0	0	0	0	0
GC 0654	Wheat	3	0,26				3	0,0008	0,5	0,0001	0	0	2	0,0005	1	0,0003
CM 0654	Wheat bran, unprocessed	10		2,6		0,94	0,3	0,0002	0	0	0	0	0	0	0	0
CF 1211	Wheat flour	2		0,41		0,11	214,3	0,0236	75,7	0,0083	18,9	0,0021	34,5	0,0038	115,9	0,0127
CF 1212	Wheat wholemeal	5		1,2		0,31	1	0,0003	0,3	0,0001	0	0	2,8	0,0009	1,3	0,0004
CP 1212	Wheat wholemeal bread			0,71		0,18	107,7	0,0194	38	0,0068	9,4	0,0017	74,7	0,0134	58,6	0,0105
						TOTAL =		0,0625		0,0312		0,006		0,0302		0,0912
						% ADI =		2%		1%		0%		1%		3%

ADI = 0.01 mg/kg body weight or 0.6 mg/person

Commodity				Process-ing factor		Adjusted	Middle Eastern		Far Eastern		African		Latin American		European	
		MRL	STMR			STMR	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	mg/kg		Notes	mg/kg	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
TN 0660	Almonds	0,05	0,05				0,5	0	0	0	0	0	0,1	0	1,8	0,0001
FI 0327	Banana	2	0,01				8,3	0,0001	26,2	0,0003	21	0,0002	102,3	0,001	22,8	0,0002
VB 0400	Broccoli	2	0,02				0,5	0	1	0	0	0	1,1	0	2,7	0,0001
VB 0041	Cabbages, Head	1	0,15				4,5	0,0007	8,7	0,0013	0	0	9,5	0,0014	24,1	0,0036
VR 0577	Carrot	0,1	0,025				2,8	0,0001	2,5	0,0001	0	0	6,3	0,0002	22	0,0006
MO 1280	Cattle kidney	0,01	0,01				0,1	0	0	0	0,1	0	0,2	0	0,2	0
MO 1281	Cattle liver	0,01	0,01				0,2	0	0	0	0,1	0	0,3	0	0,4	0
MM 0812	Cattle meat	1	0,02		fat		18,5	0,0004	3,5	0,0001	10,4	0,0002	30	0,0006	63,3	0,0013
VB 0404	Cauliflower	0,05	0,01				1,3	0	1,5	0	0	0	0,3	0	13	0,0001
VL 0467	Chinese cabbage, "Pe-tsai"	1	0,18				0,1	0	0,1	0	0,1	0	0,1	0	0,1	0
FC 0001	Citrus fruits	2	0,08				54,3	0,0043	6,3	0,0005	5,1	0,0004	54,8	0,0044	49	0,0039
VP 0526	Common bean (pods / im.seeds)	0,01	0,01				3,5	0	0,8	0	0	0	4	0	12	0,0001
SB 0716	Coffee	0,05	0,014	0,34	1/	0,005	5,3	0,0001	0,4	0	0	0	3,6	0	7,9	0,0001
DF 0269	Dried grapes	0,1	0,017				0,3	0	0	0	0	0	0,3	0	2,3	0
PE 0112	Eggs	0,01*	0,001				14,6	0	13,1	0	3,7	0	11,9	0	37,6	0
FB 0269	Grapes	0,5	0,085				15,5	0,0013	1	0,0001	0	0	1	0,0001	11,5	0,001
GC 0645	Maize	0,05	0,015				48,3	0,0007	31,2	0,0005	106,2	0,0016	41,8	0,0006	8,8	0,0001
OR 0645	Maize oil, edible	0,2		1,5		0,022	1,8	0,0001	0	0	0,3	0	0,5	0	1,3	0
ML 0107	Milks of cattle, goats & sheep	0,02	0,005				114,5	0,0006	32	0,0002	41,3	0,0002	160	0,0008	294	0,0015
VA 0385	Onion, bulb	0,2	0,04				23	0,0009	11,5	0,0005	7,3	0,0003	13,8	0,0006	27,8	0,0011
FS 0247	Peach	0,5	0,042				2,5	0,0001	0,5	0	0	0	0,8	0	12,5	0,0005
VP 0063	Peas (pods & succulent=im. seeds)	0,01	0,01				5,5	0,0001	0,7	0	0	0	0,3	0	14	0,0001
TN 0672	Pecan	0,05	0,05				0	0	0	0	0	0	0	0	0,3	0
VO 0445	Peppers, sweet	2	0,38				3,3	0,0012	2	0,0008	5,3	0,002	2,3	0,0009	10,3	0,0039

MO 0818	Pig, Edible offal of	0,01*															
MM 0818	Pig meat	0,02															
FS 0014	Plums (including prunes)	0,5	0				0	0	1	0	0	0	1	0	5	0	
FP 0009	Pome fruits	1	0,001				0	0	27,2	0	2,6	0	10,5	0	75,8	0,0001	
PM 0110	Poultry meat	0,01	0,04				1,8	0,0001	0,5	0	0	0	0	0	4,3	0,0002	
PO 0111	Poultry, edible offal of	0,01*	0,17				10,8	0,0018	7,5	0,0013	0,3	0	6,5	0,0011	51,3	0,0087	
MO 0822	Sheep, Edible offal of	0,01	0,001				31	0	13,1	0	5,5	0	25,3	0	53	0,0001	
MM 0822	Sheep meat	1	0				0,1	0	0,1	0	0,1	0	0,4	0	0,4	0	
GC 0651	Sorghum	0,5	0,01				1,3	0	0	0	0,5	0	0	0	1,3	0	
	Sorghum flour		0,02				13,5	0,0003	0,7	0	2	0	3	0,0001	10,3	0,0002	
FB 0275	Strawberry	0,3	0,04														
VR 0596	Sugar beet	0,05		0,2		0,008	13,5	0,0001	0,7	0	2	0	3	0	10,3	0,0001	
VO 0447	Sweet corn	0,01*	0,09				0	0	0	0	0	0	0	0	5,3	0,0005	
VO 0448	Tomato	0,5	0,015				0,5	0	0	0	0	0	0,3	0	2	0	
VJ 0448	Tomato juice		0,01				0	0	0	0	4,4	0	0	0	8,3	0,0001	
	Tomato paste		0,13				44,1	0,0057	5,7	0,0007	14,6	0,0019	25,5	0,0033	38,2	0,005	
TN 0678	Walnuts	0,05*		0,2		0,026	0,3	0	0	0	0	0	0	0	2	0,0001	
GC 0654	Wheat	0,5		0,2		0,026	5,8	0,0001	0,2	0	0,3	0	0	0	4	0,0001	
CF 1211	Wheat flour	0,1	0,05				0	0	0	0	0	0	0	0	0,5	0	
CM 0654	Wheat bran, unprocessed		0,015				4,3	0,0001	0,8	0	0	0	4,8	0,0001	2,2	0	
	1/ Based on roasting			0,2		0,003	323	0,0006	114	0,0002	28,3	0,0001	112	0,0002	175,8	0,0004	
				2,5		0,038	0,3	0	0	0	0	0	0	0	0	0	
						TOTAL =		0,01964805		0,00658563		0,00708858		0,01553995		0,03392042	
						% ADI =		3%		1%		1%		3%		6%	

DDT (21) THEORETICAL MAXIMUM DAILY INTAKE (TMDI)

PTDI = 0.01 mg/kg bodyweight or 0.6 mg/person

Commodity				Middle Eastern		Far Eastern		African		Latin American		European	
		MRL		Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	Notes	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
VR 0577	Carrot	0,2		2,8	0,0006	2,5	0,0005	0	0	6,3	0,0013	22	0,0044
GC 0080	Cereal grains	0,1		430,8	0,0431	452,3	0,0452	318,4	0,0318	252,5	0,0252	226,3	0,0226
PE 0112	Eggs	0,1		14,6	0,0015	13,1	0,0013	3,7	0,0004	11,9	0,0012	37,6	0,0038
MM 0095	Meat	5	fat 1/	7,4	0,037	6,6	0,0328	4,8	0,0238	9,4	0,047	31,1	0,1555
ML 0106	Milks	0,02		116,8	0,0023	32	0,0006	41,8	0,0008	160	0,0032	294	0,0059
PM 0110	Poultry meat	0,3	fat 1/	3,1	0,0009	1,3	0,0004	0,6	0,0002	2,5	0,0008	5,3	0,0016
				TOTAL =	0,0854		0,080873		0,057		0,078644		0,19376
				% PTDI =	14%		15%		10%		13%		32%
		Rounded % PTDI =			10%		10%		10%		10%		30%

1/ Based on violation rates of 0.1% for both meat and poultry meat

DELTAMETHRIN (135) THEORETICAL MAXIMUM DAILY INTAKE (TMDI)

ADI = 0.01 mg/kg bodyweight or 0.6 mg/person

Commodity				Middle Eastern		Far Eastern		African		Latin American		European	
		MRL		Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	Notes	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
VS 0620	Artichoke, globe	0,05		2,3	0,0001	0	0	0	0	0	0	5,5	0,0003
FI 0327	Banana	0,05		8,3	0,0004	26,2	0,0013	21	0,0011	102,3	0,0051	22,8	0,0011
VD 0071	Beans (dry)	1		6,8	0,0068	6,8	0,0068	0	0	13,5	0,0135	4,3	0,0043
VB 0040	Brassica vegetables	0,2		6,3	0,0013	11,2	0,0022	0	0	10,8	0,0022	39,8	0,008
VA 0036	Bulb vegetables, except Fennel, Bulb	0,1		24,9	0,0025	13,6	0,0014	7,2	0,0007	14,2	0,0014	30,7	0,0031
SB 0715	Cacao beans	0,05		0,5	0	0	0	0	0	1,3	0,0001	3,1	0,0002
GC 0080	Cereal grains (except wheat)	1		106,6	0,1066	338	0,338	290,1	0,2901	137,7	0,1377	49,3	0,0493
SB 0716	Coffee beans	2		5,3	0,0106	0,4	0,0008	0	0	3,6	0,0072	7,9	0,0158
MO 0105	Edible offal (Mammalian)	0,05	1/	4,2	0,0002	1,4	0,0001	2,4	0,0001	6,1	0,0003	12,4	0,0006
PE 0112	Eggs	0,01		14,6	0,0001	13,1	0,0001	3,7	0	11,9	0,0001	37,6	0,0004
VD 0561	Field pea (dry)	1		0,5	0,0005	1,7	0,0017	0	0	1,3	0,0013	1,8	0,0018
FT 0297	Fig	0,01		2,3	0	0	0	0	0	0,3	0	0,5	0
VO 0050	Fruiting vegetables other than Cucurbits	0,2		91,8	0,0184	12	0,0024	22,5	0,0045	33,8	0,0068	74,5	0,0149
VC 0045	Fruiting vegetables, Cucurbits	0,2		80,5	0,0161	18,2	0,0036	0	0	30,5	0,0061	38,5	0,0077
FB 0269	Grapes	0,05		15,8	0,0008	1	0,0001	0	0	1,3	0,0001	13,8	0,0007
DH 1100	Hops, dry	5		0,1	0,0005	0,1	0,0005	0,1	0,0005	0,1	0,0005	0,1	0,0005
FI 0341	Kiwifruit	0,05		0	0	0	0	1,9	0,0001	0,1	0	1,5	0,0001
VL 0053	Leafy vegetables	0,5		1,5	0,0008	1,5	0,0008	0	0	5,8	0,0029	11,5	0,0058
VP 0060	Legume vegetables	0,1		9,5	0,001	1,5	0,0002	0	0	4,3	0,0004	26	0,0026
VD 0533	Lentil (dry)	1		2,8	0,0028	0,7	0,0007	0	0	0	0	2,3	0,0023
FC 0003	Mandarins	0,05		8,8	0,0004	0,2	0	0	0	6,3	0,0003	6	0,0003
MM 0095	Meat	0,5	fat 1/	7,4	0,0037	6,6	0,0033	4,8	0,0024	9,4	0,0047	31,1	0,0156
VC 0046	Melons, except watermelon	0,01		16	0,0002	2	0	0	0	2,8	0	18,3	0,0002
ML 0106	Milks	0,02	1/	116,8	0,0023	32	0,0006	41,8	0,0008	160	0,0032	294	0,0059
VO 0450	Mushrooms	0,01		0,3	0	0,5	0	0	0	0	0	4	0

SO 0088	Oilseed	0,1		23,7	0,0024	4,4	0,0004	2,4	0,0002	3,1	0,0003	15,8	0,001
SO 0089	Oilseed, except peanut	0,1		23,4	0,0023	4,2	0,0004	0,1	0	2,8	0,0003	12,8	0,0013
FT 0305	Olives	0,1		1,3	0,0001	0	0	0	0	0,3	0	2,8	0,0003
FC 0004	Oranges, Sweet, Sour	0,05		31,5	0,0016	4	0,0002	4,8	0,0002	31	0,0016	29,8	0,0015
SO 0697	Peanut	0,01		0,3	0	0,2	0	2,3	0	0,3	0	3	0
FI 0353	Pineapple	0,01		0	0	0,8	0	10,2	0,0001	3,1	0	15,8	0,0002
FP 0009	Pome fruits	0,1		10,8	0,0011	7,5	0,0008	0,3	0	6,5	0,0007	51,3	0,0051
PM 0110	Poultry meat	0,01		31	0,0003	13,2	0,0001	5,5	0,0001	25,3	0,0003	53	0,0005
PO 0111	Poultry, edible offal of	0,01		0,1	0	0,1	0	0,1	0	0,4	0	0,4	0
VR 0075	Root and tuber vegetables	0,01		61,8	0,0006	108,5	0,0011	321,3	0,0032	159,3	0,0016	242	0,0024
FS 0012	Stone fruits	0,05		7,3	0,0004	1	0,0001	0	0	0,8	0	22,8	0,0011
FB 0275	Strawberry	0,05		0	0	0	0	0	0	0	0	5,3	0,0003
DT 1114	Tea, green, black	10		2,3	0,023	1,2	0,012	0,5	0,005	0,5	0,005	2,3	0,023
FT 0312	Tree tomato	0,02		0	0	1,9	0	0,1	0	1,5	0	0,1	0
CM 0654	Wheat bran, unprocessed	5		0,3	0,0013	0	0	0	0	0	0	0	0
CF 1211	Wheat flour	0,2		323	0,0646	114	0,0228	28,3	0,0057	112	0,0224	175,8	0,0352
CF 1212	Wheat wholemeal	1		1	0,001	0,3	0,0003	0	0	2,8	0,0028	1,3	0,0013
				TOTAL =	0,2746		0,4027		0,3149		0,2287		0,2149
1/ Residues arising from veterinary use				% ADI =	46%		73%		52%		38%		36%
		Rounded % ADI =			50%		70%		50%		40%		40%

DODINE (84) THEORETICAL MAXIMUM DAILY INTAKE (TMDI)

ADI = 0.1 mg/kg body weight or 6.0 mg/person

Commodity				Middle Eastern		Far Eastern		African		Latin American		European	
		MRL		Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	Notes	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
FP 0226	Apple	5		7,5	0,0375	4,7	0,0233	0,3	0,0013	5,5	0,0275	40	0,2
FS 0013	Cherries	2		0	0	0	0	0	0	0	0	3	0,006
FB 0269	Grapes	5		15,8	0,0788	1	0,005	0	0	1,3	0,0063	13,8	0,0688
FS 0247	Peach	5		2,5	0,0125	0,5	0,0025	0	0	0,8	0,0038	12,5	0,0625
FP 0230	Pear	5		3,3	0,0163	2,8	0,0142	0	0	1	0,005	11,3	0,0563
FB 0275	Strawberry	5		0	0	0	0	0	0	0	0	5,3	0,0263
				TOTAL =	0,145		0,045		0,0013		0,0425		0,4198
				% ADI =	2%		1%		0%		1%		7%

ADI = 0.005 mg/kg bodyweight or 0.3 mg/person

Commodity				Middle Eastern		Far Eastern		African		Latin American		European	
		MRL		Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	Notes	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
FP 0226	Apple	0,5		7,5	0,0038	4,7	0,0023	0,3	0,0001	5,5	0,0028	40	0,02
VB 0041	Cabbages, Head	0,5		5	0,0025	9,7	0,0048	0	0	10,5	0,0053	26,8	0,0134
SB 0715	Cacao beans	0,1		0,5	0,0001	0	0	0	0	1,3	0,0001	3,1	0,0003
VB 0404	Cauliflower	0,1		1,3	0,0001	1,5	0,0002	0	0	0,3	0	13	0,0013
GC 0080	Cereal grains	10	1/	54,7	0,547	60	0,6	221,3	2,213	70,2	0,702	39	0,39
FS 0013	Cherries	0,5		0	0	0	0	0	0	0	0	3	0,0015
FC 0001	Citrus fruits	2		54,3	0,1085	6,3	0,0127	5,1	0,0102	54,8	0,1095	49	0,098
VC 0424	Cucumber	0,05		4,8	0,0002	4,5	0,0002	0	0	8,3	0,0004	9	0,0005
VO 0440	Egg plant	0,1		6,3	0,0006	3	0,0003	0,7	0,0001	6	0,0006	2,3	0,0002
FB 0269	Grapes	0,5		15,8	0,0079	1	0,0005	0	0	1,3	0,0006	13,8	0,0069
VA 0384	Leek	0,2		0,5	0,0001	0	0	0	0	0,3	0,0001	2	0,0004
VL 0482	Lettuce, Head	0,5		2,3	0,0011	0	0	0	0	5,8	0,0029	22,5	0,0113
MM 0095	Meat	0,05	fat	7,4	0,0004	6,6	0,0003	4,8	0,0002	9,4	0,0005	31,1	0,0016
ML 0106	Milks	0,002		116,8	0,0002	32	0,0001	41,8	0,0001	160	0,0003	294	0,0006
VA 0385	Onion, bulb	0,05		23	0,0012	11,5	0,0006	7,3	0,0004	13,8	0,0007	27,8	0,0014
FS 0247	Peach	1		2,5	0,0025	0,5	0,0005	0	0	0,8	0,0008	12,5	0,0125
FP 0230	Pear	0,5		3,3	0,0016	2,8	0,0014	0	0	1	0,0005	11,3	0,0056
VP 0063	Peas	0,5		5,5	0,0028	0,7	0,0004	0	0	0,3	0,0002	14	0,007
VO 0051	Peppers	0,1		3,4	0,0003	2,1	0,0002	5,4	0,0005	2,4	0,0002	10,4	0,001
VR 0589	Potato	0,05		59	0,003	19,2	0,001	20,6	0,001	40,8	0,002	240,8	0,012
VR 0494	Radish	0,2		0,5	0,0001	0	0	0	0	0,3	0,0001	2	0,0004
CM 1206	Rice bran, unprocessed	20		0	0	0	0	0	0	0	0	0	0
CM 1205	Rice, polished	1		48,8	0,0488	277,5	0,2775	68,8	0,0688	65,5	0,0655	9,3	0,0093
VD 0541	Soya bean (dry)	0,1		4,5	0,0005	2	0,0002	0,5	0,0001	0	0	0	0
FB 0275	Strawberry	0,5		0	0	0	0	0	0	0	0	5,3	0,0026
DT 1114	Tea, Green, Black	0,5		2,3	0,0012	1,2	0,0006	0,5	0,0003	0,5	0,0003	2,3	0,0012
VO 0448	Tomato	0,5		81,5	0,0408	7	0,0035	16,5	0,0083	25,5	0,0128	66	0,033
CF 0654	Wheat bran, processed	2		0,3	0,0006	0	0	0	0	0	0	0	0
CF 1211	Wheat flour	2		110,7	0,2214	38,5	0,077	9,4	0,0188	75,7	0,1514	59,5	0,119
CF 1212	Wheat wholemeal	5		1	0,005	0,3	0,0017	0	0	2,8	0,0138	1,3	0,0063
CP 1211	White bread	0,2		215,3	0,0431	76	0,0152	18,9	0,0038	37,3	0,0075	117,2	0,0234
	1/ Except wheat and rice			TOTAL =	1,0451		1,0011		2,3255		1,0805		0,7806
				% ADI =	348%		363%		775%		360%		260%
		Rounded % ADI =			350%		360%		780%		360%		260%

ADI = 0.007 mg/kg body weight or 0.42 mg/person

Commodity				Process-ing factor		Adjusted	Middle Eastern		Far Eastern		African		Latin American		European	
		MRL	STMR			STMR	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	mg/kg		Notes	mg/kg	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
FS 0013	Cherries	2					0	0	0	0	0	0	0	0	3	0,006
FC 0003	Mandarins	0,5					8,8	0,0044	0,2	0,0001	0	0	6,3	0,0031	6	0,003
OC 0305	Olive oil, virgin	3					1,5	0,0045	0	0	0	0	0	0	7,8	0,0233
FT 0305	Olives	1					1,3	0,0013	0	0	0	0	0,3	0,0003	2,8	0,0028
FC 0004	Oranges, sweet sour	0,5					31,5	0,0158	4	0,002	4,8	0,0024	31	0,0155	29,8	0,0149
CM 0649	Rice, husked	0,05	0,0145				48,8	0,0007	279,3	0,004	103,4	0,0015	86,5	0,0013	11,8	0,0002
							TOTAL =	0,0265826		0,00613318		0,00391597		0,02012925		0,0500461
							% ADI =	6%		1%		1%		5%		12%
					Rounded % ADI =			6%		1%		1%		5%		10%

IMAZALIL (110) THEORETICAL MAXIMUM DAILY INTAKE (TMDI)

ADI = 0.03 mg/kg body weight or 1.8 mg/person

Commodity				Middle Eastern		Far Eastern		African		Latin American		European	
		MRL		Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	Notes	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
FI 0327	Banana	2		8,3	0,0165	26,2	0,0523	21	0,042	102,3	0,2045	22,8	0,0455
FC 0001	Citrus fruits	5		54,3	0,2713	6,3	0,0317	5,1	0,0254	54,8	0,2738	49	0,245
VC 0424	Cucumber	0,5		2,4	0,0012	2,3	0,0011	0	0	4,1	0,0021	4,5	0,0023
VC 0425	Gherkin	0,5		2,4	0,0012	2,3	0,0011	0	0	4,1	0,0021	4,5	0,0023
FT 0307	Persimmon, Japanese	2		0	0	1	0,002	0	0	0,3	0,0005	0	0
FP 0009	Pome fruits	5		10,8	0,0538	7,5	0,0375	0,3	0,0013	6,5	0,0325	51,3	0,2565
VR 0589	Potato	5		59	0,295	19,2	0,0958	20,6	0,1029	40,8	0,2038	240,8	1,2038
FB 0272	Raspberries, Red, Black	2		0	0	0	0	0	0	0	0	0,5	0,001
FB 0275	Strawberry	2		0	0	0	0	0	0	0	0	5,3	0,0105
GC 0654	Wheat	0,01		327,3	0,0033	114,8	0,0011	28,3	0,0003	116,8	0,0012	178	0,0018
			TOTAL =		0,6421475		0,22273167		0,17186667		0,7202925		1,76853
			% ADI =		36%		13%		10%		40%		98%
		Rounded % ADI =			40%		10%		10%		40%		100%

MALATHION (49) INTERNATIONAL ESTIMATED DAILY INTAKE (IEDI)

ADI = 0.3 mg/kg body weight or 18 mg/person

Commodity				Process-ing factor		Adjusted	Middle Eastern		Far Eastern		African		Latin American		European	
		MRL	STMR		Notes	STMR	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	mg/kg			mg/kg	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
VS 0621	Asparagus	1	0,305				0	0	0	0	0	0	0	0	1,5	0,0005
VD 0071	Beans (dry)	2	0,36				6,8	0,0024	6,8	0,0024	0	0	13,5	0,0049	4,3	0,0015
VP 0061	Beans, except broad and soya beans	1	0,31				0,1	0	0,1	0	0,1	0	0,1	0	0,1	0
FB 0020	Blueberries	10	2,27				0	0	0	0	0	0	0	0	0,5	0,0011
OR 0691	Cotton seed oil, refined	13	3,06				3,8	0,0115	0,5	0,0015	0,5	0,0015	0,5	0,0015	0	0
VC 0424	Cucumber	0,2	0,02				4,8	0,0001	4,5	0,0001	0	0	8,3	0,0002	9	0,0002
GC 0645	Maize	0,05	0,01				48,3	0,0005	31,2	0,0003	106,2	0,0011	41,8	0,0004	8,8	0,0001
VL 0485	Mustard green	2	0,07				0,1	0	0,1	0	0,1	0	0,1	0	0,1	0
VA 0385	Onion, bulb	1	0,23				23	0,0053	11,5	0,0026	7,3	0,0017	13,8	0,0032	27,8	0,0064
VA 0388	Onion, green	5	0,52				0	0	2	0,001	1,5	0,0008	4	0,0021	1	0,0005
VO 0051	Peppers	0,1	0,01				3,4	0	2,1	0	5,4	0,0001	2,4	0	10,4	0,0001
VL 0502	Spinach	3	0,35				0,5	0,0002	0	0	0	0	0,3	0,0001	2	0,0007
FB 0275	Strawberry	1	0,25				0	0	0	0	0	0	0	0	5,3	0,0013
VO 0447	Sweet corn	0,02	0,01				0	0	0	0	4,4	0	0	0	8,3	0,0001
GC 0651	Sorghum	3	0,235				2	0,0005	9,7	0,0023	26,6	0,0062	0	0	0	0
VO 0448	Tomato	0,5	0,21				80,9	0,017	7	0,0015	16,5	0,0035	25,5	0,0054	62	0,013
VJ 0448	Tomato, juice	0,01	0				0,3	0	0	0	0	0	0	0	2	0
	Tomato, puree			0,334		0,0701	0,3	0	0	0	0	0	0	0	2	0,0001
VR 0506	Turnip, Garden	0,2	0,05				0,5	0	0	0	0	0	0,3	0	2	0,0001
GC 0654	Wheat	0,5	0,04				4,3	0,0002	0,8	0	0	0	4,8	0,0002	2,3	0,0001
CF 1211	Wheat flour	0,2		0,23		0,0092	323	0,003	114	0,001	28,3	0,0003	112	0,001	175,8	0,0016
							TOTAL =	0,04068414		0,01294747		0,01516708		0,0189524		0,02751518
							% ADI =	0%		0%		0%		0%		0%

ADI = 0.004 mg/kg bodyweight or 0.24 mg/person

Commodity				Process-ing factor		Adjusted	Middle Eastern		Far Eastern		African		Latin American		European	
		MRL	STMR			STMR	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	mg/kg		Notes	mg/kg	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
FP 0226	Apple	0,2	0,025				7,5	0,0002	4,7	0,0001	0,3	0	5,5	0,0001	40	0,001
GC 0640	Barley	7	1,95				1	0,002	3,5	0,0068	1,8	0,0034	6,5	0,0127	19,8	0,0385
GC 0645	Maize	0,1	0,05				6,5	0,0003	0	0	0	0	1,5	0,0001	0	0
CF 1255	Maize flour	0,1	0,034	0,68		0,034	31,8	0,0011	31,2	0,0011	106,2	0,0036	40,3	0,0014	8,8	0,0003
OR 0645	Maize oil, edible	0,3	0,12	2,4	1/	0,12	1,8	0,0002	0	0	0,3	0	0,5	0,0001	1,3	0,0002
GC 0651	Sorghum	5	1,06													
	Sorghum flour		0,42	0,4		0,42	2	0,0008	9,7	0,0041	26,6	0,0112	0	0	0	0
VD 0541	Soya bean (dry)	0,05*	0,05				4,5	0,0002	2	0,0001	0,5	0	0	0	0	0
SO 0702	Sunflower seed	0,05*	0,05				1	0,0001	0	0	0,6	0	0	0	0	0
OR 0702	Sunflower seed oil, edible	0,05*	0,021	0,42		0,021	9,3	0,0002	0,5	0	0,3	0	0,8	0	8,5	0,0002
VO 0447	Sweet corn (corn-on-the-cob)	0,05*	0,05				0	0	0	0	4,4	0,0002	0	0	8,3	0,0004
GC 0654	Wheat	1	0,125				4	0,0005	0,8	0,0001	0	0	4,8	0,0006	2,2	0,0003
CM 0654	What bran, unprocessed		0,58	4,6		0,58	0,3	0,0001	0	0	0	0	0	0	0	0
CF 1211	Wheat flour		0.044	0,36		0,044	323	0,0142	114	0,005	28,3	0,0012	112	0,0049	175,8	0,0077
	1/ Based on processing factor for wet milling						TOTAL =	0,0199		0,0173		0,0197		0,0199		0,0486
							% ADI =	8%		7%		8%		8%		20%

ADI = 0.003 mg/kg bodyweight or 0.18 mg/person

Commodity				Process-ing factor		Adjusted	Middle Eastern		Far Eastern		African		Latin American		European	
		MRL	STMR			STMR	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	mg/kg		Notes	mg/kg	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
FP 0226	Apples	0,2	0,06				7,5	0,0005	4,7	0,0003	0,3	0	5,5	0,0003	40	0,0024
VD 0071	Beans (dry)	0,05*	0,05				6,8	0,0003	6,8	0,0003	0	0	13,5	0,0007	4,3	0,0002
VB 0041	Cabbages, head	0,05	0,05				5	0,0003	9,7	0,0005	0	0	10,5	0,0005	26,8	0,0013
OR 0691	Cotton seed oil, edible	10	1,16	0,33		1,16	3,8	0,0044	0,5	0,0006	0,5	0,0006	0,5	0,0006	0	0
DF 0269	Dried grapes (= Currants,	1	0,14	1,4		0,14	0,3	0	0	0	0	0	0,3	0	2,3	0,0003
	Raisins and Sultanas)															
FB 0269	Grapes	0,5	0,1				15,8	0,0016	1	0,0001	0	0	1,3	0,0001	13,8	0,0014
GC 0645	Maize	0,1	0,05				6,5	0,0003	0	0	0	0	1,5	0,0001	0	0
CF 1255	Maize flour	0,05	0,021	0,41		0,021	31,8	0,0007	31,2	0,0007	106,2	0,0022	40,3	0,0008	8,8	0,0002
OR 0645	Maize oil, edible	0,1	0,051	1,3		0,051	1,8	0,0001	0	0	0,3	0	0,5	0	1,3	0,0001
FS 0247	Peach	0,3	0,095				2,5	0,0002	0,5	0	0	0	0,8	0,0001	12,5	0,0012
VD 0072	Peas (dry)	0,3	0,06				0,5	0	1,7	0,0001	0	0	1,3	0,0001	1,8	0,0001
VR 0589	Potato	0,05*	0				59	0	19,2	0	20,6	0	40,8	0	240,8	0
OR 0495	Rape seed oil, edible	0,2	0,1	2	1/	0,1	4,5	0,0005	2,7	0,0003	0	0	0,3	0	7,3	0,0007
VR 0596	Sugar beet	0,05*	0				0,5	0	0	0	0	0	0,3	0	2	0
GC 0654	Wheat	5	0,29				4,3	0,0012	0,8	0,0002	0	0	4,8	0,0014	2,2	0,0006
CM 0654	Wheat bran, unprocessed	10	0,64	2,2		0,64	0,3	0,0002	0	0	0	0	0	0	0	0
CF 1211	Wheat flour	2	0,11	0,39		0,11	323	0,0355	114	0,0125	28,3	0,0031	112	0,0123	175,8	0,0193
	1/ Processing factor applied to rape seed MRL of 0.05 mg/kg						TOTAL =	0,0457		0,0156		0,006		0,0171		0,0279
							% ADI =	25%		9%		3%		9%		15%
					Rounded %ADI =			30%		9%		3%		9%		20%

PYRETHRINS (63) INTERNATIONAL ESTIMATED DAILY INTAKE (IEDI)

ADI = 0.04 mg/kg bodyweight or 2.4 mg/person

Commodity				Process-ing factor		Adjusted	Middle Eastern		Far Eastern		African		Latin American		European	
		MRL	STMR		Notes	STMR	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	mg/kg			mg/kg	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
FC 0001	Citrus fruits	0,05	0,04	1		0,04	54,3	0,0022	6,3	0,0003	5,1	0,0002	54,8	0,0022	49	0,002
DF 0167	Dried fruits	0,2	0,05	1	Po	0,05	1,2	0,0001	0,3	0	0,4	0	0,4	0	2,9	0,0001
VC 0045	Fruiting vegetables, curcubits	0,05*	0,04	1		0,04	80,5	0,0032	18,2	0,0007	0	0	30,5	0,0012	38,5	0,0015
SO 0697	Peanut	0,5	0,05	1	Po	0,05	0,3	0	0,2	0	2,3	0,0001	0,3	0	3	0,0002
VO 0051	Peppers	0,05*	0,04	1		0,04	3,4	0,0001	2,1	0,0001	5,4	0,0002	2,4	0,0001	10,4	0,0004
VD 0070	Pulses	0,1	0,05	1		0,05	24,6	0,0012	19,8	0,001	17,8	0,0009	23,1	0,0012	12,1	0,0006
VR 0075	Root and tuber vegetables	0,05*	0	1		0	61,8	0	108,5	0	321,3	0	159,3	0	242	0
VO 0448	Tomato	0,05*	0,04	1		0,04	81,2	0,0032	7	0,0003	16,5	0,0007	25,5	0,001	63,8	0,0026
VJ 0448	Tomato juice			0,45		0,018	0,3	0	0	0	0	0	0	0	2	0
	Tomato puree			0,45		0,018	5,8	0	0,2	0	0,3	0	0	0	4	0,0001
							TOTAL =	0,0101		0,0024		0,0021		0,0057		0,0075
							% ADI =	0%		0%		0%		0%		0%

PYRIPROXIFEN (200) INTERNATIONAL ESTIMATED DAILY INTAKE (IEDI)

ADI = 0.1 mg/kg bodyweight or 6 mg/person

Commodity				Process-ing factor		Adjusted	Middle Eastern		Far Eastern		African		Latin American		European	
		MRL	STMR			STMR	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	mg/kg		Notes	mg/kg	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
MM 0812	Cattle meat	0,01*	0		fat	0	2,7	0	0,7	0	2,1	0	6	0	12,7	0
MO 0812	Cattle, Edible offal of	0,01*	0			0	2,5	0	0,3	0	1,8	0	5	0	6	0
FC 0001	Citrus fruits	1	0,013			0,013	54,3	0,0007	6,3	0,0001	5,1	0,0001	54,8	0,0007	49	0,0006
JF 0004	Orange juice		0,0036	0,28		0,0036	22,8	0,0007	0	0,0001	0	0,0001	0	0,0007	13,5	0,0006
OR 0691	Cotton seed oil, edible	0,01	0,002			0,002	3,8	0	0,5	0	0,5	0	0,5	0	0	0
MM 0814	Goat meat	0,01*	0		fat	0	0,4	0	0	0	0,5	0	0,2	0	0,1	0
MO 0814	Goat, Edible offal of	0,01*	0			0	0,3	0	0	0	0,4	0	0	0	0	0
							TOTAL =	0,0007		0,0001		0,0001		0,0007		0,0006
							% ADI =	0%		0%		0%		0%		0%

THIABENDAZOLE (65) INTERNATIONAL ESTIMATED DAILY INTAKE (IEDI)

ADI = 0.1 mg/kg bodyweight or 6 mg/person

Commodity				Process-ing factor		Adjusted	Middle Eastern		Far Eastern		African		Latin American		European	
		MRL	STMR			STMR	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	mg/kg		Notes	mg/kg	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
FI 0326	Avocado	15	0,9		Po		0	0	0	0	0,2	0,0001	3,3	0,0029	1	0,0009
FI 0327	Banana	5	0,029				8,3	0,0002	26,2	0,0008	21	0,0006	102,3	0,003	22,8	0,0007
MM 0812	Cattle meat	0,1	0,02				18,5	0,0004	3,5	0,0001	10,4	0,0002	30	0,0006	63,3	0,0013
ML 0812	Cattle milk	0,2	0,12				79,5	0,0095	23,2	0,0028	35,8	0,0043	159,3	0,0191	287	0,0344
MO 1280	Cattle kidney	1	0,5				0,1	0,0001	0	0	0,1	0	0,2	0,0001	0,2	0,0001
MO 1281	Cattle liver	0,3	0,2				0,2	0	0	0	0,1	0	0,3	0,0001	0,4	0,0001
FC 0001	Citrus fruits	3	0,01		Po		54,3	0,0005	6,3	0,0001	5,1	0,0001	54,8	0,0005	49	0,0005
MO 0096	Edible offal of goats/pigs/sheep 2/	0,1	0,1		1/		4,1	0,0004	1,3	0,0001	2,7	0,0003	6	0,0006	12,3	0,0012
PE 0112	Eggs	0,1	0,1				14,6	0,0015	13,1	0,0013	3,7	0,0004	11,9	0,0012	37,6	0,0038
ML 0814	Goat milk	0,1	0,1		1/		14	0,0014	0,7	0,0001	3,6	0,0004	0,8	0,0001	2,3	0,0002
FI 0345	Mango	5	2,85		Po		2,3	0,0064	5,3	0,0152	3,4	0,0097	6,3	0,0178	0	0
MM 0096	Meat of goats/pigs/sheep 2/	0,1	0,1		1/		34	0,0034	32	0,0032	17,5	0,0018	44,3	0,0044	150,3	0,015
VC 0046	Melons (except watermelon)	1	0,43				16	0,0069	2	0,0009	0	0	2,8	0,0012	18,3	0,0079
VO 0450	Mushroom	60	31				0,3	0,0078	0,5	0,0155	0	0	0	0	4	0,124
FI 0350	Papaya	10	3,8		Po		0	0	0,2	0,0006	0	0	5,3	0,02	0	0
VR 0589	Potato	15	5,4	0,2	3/	1,08	59	0,0637	19,2	0,0207	20,6	0,0222	40,8	0,044	240,8	0,26
FP 0009	Pome fruits	3	1,7		Po		10,8	0,0183	7,5	0,0128	0,3	0,0004	6,5	0,0111	51,3	0,0872
PM 0110	Poultry meat	0,05	0,05				31	0,0016	13,2	0,0007	5,5	0,0003	25,3	0,0013	53	0,0027
FB 0275	Strawberry	5	1,6				0	0	0	0	0	0	0	0	5,3	0,0084
VS 0469	Witloof chicory (sprouts)	0,05	0,05				0,5	0	0	0	0	0	0,3	0	2	0,0001
	1/ Residues arising from veterinary use						TOTAL =	0,12206425		0,0746895		0,040778		0,12786175		0,54841375
	2/ Except horses and cattle						% ADI =	2%		1%		1%		2%		9%
	3/ Processing factor is based on washing															

ADI = 0.03 mg/kg bodyweight or 1.80 mg/person

Commodity				Middle Eastern		Far Eastern		African		Latin American		European	
		MRL 1/		Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI	Diet	IEDI
Code	Name	mg/kg	Notes	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day	g/day	mg/day
VS 0621	Asparagus	2		0	0	0	0	0	0	0	0	1,5	0,003
GC 0640	Barley	0,5		1	0,0005	3,5	0,0018	1,8	0,0009	6,5	0,0033	19,8	0,0099
VD 0071	Beans, dry	0,1		6,8	0,0007	6,8	0,0007	0	0	13,5	0,0014	4,3	0,0004
VB 0041	Cabbages, head	5		5	0,025	9,7	0,0483	0	0	10,5	0,0525	26,8	0,1338
VB 0404	Cauliflower	2		1,3	0,0025	1,5	0,003	0	0	0,3	0,0005	13	0,026
VS 0624	Celery	2		0,5	0,001	0	0	0	0	0,3	0,0005	2	0,004
FC 0001	Citrus fruits	1		54,3	0,0543	6,3	0,0063	5,1	0,0051	54,8	0,0548	49	0,049
VP 0526	Common bean (pods/im seeds)	2		3,5	0,007	0,8	0,0017	0	0	4	0,008	12	0,024
VC 0424	Cucumber	0,2		4,8	0,001	4,5	0,0009	0	0	8,3	0,0017	9	0,0018
VO 0440	Egg plant	0,2		6,3	0,0013	3	0,0006	0,7	0,0001	6	0,0012	2,3	0,0005
FB 0269	Grapes	5		15,8	0,0788	1	0,005	0	0	1,3	0,0063	13,8	0,0688
DH 1100	Hops, dry	10		0,1	0,001	0,1	0,001	0,1	0,001	0,1	0,001	0,1	0,001
VL 0480	Kale	5		0,5	0,0025	0	0	0	0	0,3	0,0013	2	0,01
VL 0482	Lettuce, head	5		2,3	0,0113	0	0	0	0	5,8	0,0288	22,5	0,1125
GC 0645	Maize	0,05	2/	48,3	0,0024	31,2	0,0016	106,2	0,0053	41,8	0,0021	8,8	0,0004
MM 0095	Meat	0,02		37	0,0007	32,8	0,0007	23,8	0,0005	47	0,0009	155,5	0,0031
VC 0046	Melons, except watermelon	0,2		16	0,0032	2	0,0004	0	0	2,8	0,0006	18,3	0,0037
ML 0106	Milks	0,02		116,8	0,0023	32	0,0006	41,8	0,0008	160	0,0032	294	0,0059
FS 0245	Nectarine	5		1,3	0,0063	0,3	0,0013	0	0	0,4	0,0019	6,3	0,0315
GC 0647	Oats	0,5		0	0	0	0	0,2	0,0001	0,8	0,0004	2	0,001
VA 0385	Onion, bulb	0,2		11,5	0,0023	5,8	0,0012	3,7	0,0007	6,9	0,0014	13,9	0,0028
VA 0387	Onion, Welsh	0,5		11,5	0,0058	5,5	0,0028	3,6	0,0018	6,9	0,0035	13,9	0,007
FS 0247	Peach	5		1,3	0,0063	0,3	0,0013	0	0	0,4	0,0019	6,2	0,031

SO 0697	Peanut	0,1		0,3	0	0,2	0	2,3	0,0002	0,3	0	3	0,0003
VP 0063	Peas	5		5,5	0,0275	0,7	0,0035	0	0	0,3	0,0015	14	0,07
VP 0064	Peas, shelled	0,5		14	0,007	0,5	0,0003	0	0	0,2	0,0001	10,1	0,0051
VO 0051	Peppers	1		3,4	0,0034	2,1	0,0021	5,4	0,0054	2,4	0,0024	10,4	0,0104
FI 0353	Pineapple	0,2		0	0	0,8	0,0002	10,2	0,002	3,1	0,0006	15,8	0,0032
FP 0009	Pome fruits	2		10,8	0,0215	7,5	0,015	0,3	0,0005	6,5	0,013	51,3	0,1026
VR 0589	Potato	0,1		59	0,0059	19,2	0,0019	20,6	0,0021	40,8	0,0041	240,8	0,0241
GC 0651	Sorghum	0,2		2	0,0004	9,7	0,0019	26,6	0,0053	0	0	0	0
VD 0541	Soya bean, dry	0,2	2/	4,5	0,0009	2	0,0004	0,5	0,0001	0	0	0	0
VP 0541	Soya bean (immature seeds)	0,1		0,1	0	0,1	0	0,1	0	0	0	0	0
VL 0502	Spinach	5		0,5	0,0025	0	0	0	0	0,3	0,0013	2	0,01
VC 0431	Squash, summer	0,2		10,5	0,0021	2,2	0,0004	0	0	14	0,0028	3,5	0,0007
VR 0596	Sugar beet	0,1		0,5	0,0001	0	0	0	0	0,3	0	2	0,0002
VO 0447	Sweet corn (corn-on-the-cob)	2	2/	0	0	0	0	4,4	0,0088	0	0	8,3	0,0166
VO 0448	Tomato	1	2/	44,1	0,0441	5,7	0,0057	14,6	0,0146	25,5	0,0255	38,2	0,0382
VC 0432	Watermelon	0,2		49,3	0,0099	9,5	0,0019	0	0	5,5	0,0011	7,8	0,0016
GC 0654	Wheat	0,5		327,3	0,1636	114,8	0,0574	28,3	0,0142	116,8	0,0584	178	0,089
			TOTAL =		0,5047		0,1697		0,0695		0,2875		0,9027
				% ADI =	28%		10%		4%		16%		50%
	ROUNDED % ADI =				30%		10%		4%		20%		50%
	1/ Residues arising from the use of methomyl unless otherwise indicated												
	2/ Residues arising from the use of thiodicarb												

ANNEX IV

ESTIMATES OF ACUTE DIETARY INTAKE

The following tables give details of the estimated acute dietary intakes of the pesticides for general population and children up to six years of age and show the ratios of the estimated intakes to the corresponding acute reference dose(RfD).

In the case of compounds for which an acute RfD might be necessary but has not yet been established, international estimated short term intakes (IESTs) were calculated, but the acute risk assessments could not be finalised. Depending on data on consumption of a commodity, the IESTI is calculated for the relevant case, as described below:

Case 1. Composite sampling data reflect the residue level in the food (unit weight of the whole portion <25g).
Case 2. Composite residue data do not reflect the residue level in individual food commodity units (unit weight of the whole portion >25g)
Case 2a. Unit weight is less than large portion weight.
Case 2b. Unit weight exceeds large portion weight.
Case 3. Processed commodity, where bulking or blending means that the STMR-P represents the likely highest ressidue.

The percentages of the acute RfD are rounded to one significant figure for valuaes up to and including 100% and to two significant figures for values above 100%.

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)

CHLORMEQUAT (15) CHILDREN

Acute RfD: 0.05 mg/kg body weight

Code	Commodity Name	MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
GC 0640	Barley	2	0,15		1,8	0,73	AUS	19	14						1	0,00131	3
	Barley beer		0,0023	0,015		0,62	AUS	19	12						3	0,000001	0
	Barley pearl		0,009	0,06											3		
	Barley malt		0,1	0,69											3		
PE 0112	Eggs	0,1	0,04		0,064	7.5 1/	FRA	17,8	134						1	0,0005	1
MM 0814	Goat meat	0,2	0,04		0,11	5,08	USA	15	76						1	0,0006	1
MO 0098	Kidney of cattle/goats/pigs/sheep	0,5	0,084		0,35	12,44	USA	15	187						1	0,00436	9
MO 0099	Liver of cattle/goats/pigs/sheep	0,1	0,042		0,88	11,39	FRA	17,8	203						1	0,01004	20
MM 0097	Meat of cattle, pigs and sheep	0,2	0,04		0,11	13,72	AUS	19	261						1	0,00151	3
ML 0107	Milk of cattle, goats and sheep	0,5	0,018			76,33	AUS	19	1450						3	0,00137	3
GC 0647	Oats	10	1,2		7,1	4,15	USA	15	62						1	0,02934	60
	Oat flakes		0,25	0,21											3		
FP 0230	Pear	10	4,2		6,3	19,24	UNK	14,5	279	100	FRA	89	89	7	2a	0,35323	700
PO 0111	Poultry, Edible offal of	0,1	0,0096		0,053	2.47	USA	15	37						1	0,00013	0
PM 0110	Poultry meat	0,04*	0		0	11,78	AUS	19	224						1	0	0
OC 0495	Rape seed oil, crude		0,037	0,018		0.97 2/	AUS	19	18						3	0,00004	0
GC 0650	Rye	3	0,26		2	2,17	NLD	17	37						1	0,00434	9
CM 0650	Rye bran, unprocessed	10	0,83	3,2		0.67 3/	AUS	19	13						3	0,00056	1
CF1250	Rye flour	3	0,26	0,99		1,18	USA	15	18						3	0,00031	1
CF1251	Rye wholemeal	4	0,34	1,3		0,68	USA	15	10						3	0,00023	0
	Rye wholemeal bread		0,25	0,95											3		
GC 0653	Triticale	3	0,26		2										1		
GC 0654	Wheat	3	0,26		2	10,07	USA	15	151						1	0,02014	40
CM 0654	Wheat bran, unprocessed	10	0,94	2,6		1,98	USA	15	30						3	0,00186	4
CF1211	Wheat flour	2	0,11	0,41		10,23	AUS	19	194						3	0,00113	2
CF1212	Wheat wholemeal	5	0,31	1,2		4,91	USA	15	74						3	0,00152	3
	Wheat wholemeal bread		0,18	0,71											3		

1/ Consumption for PE 0840 chicken eggs
2/ Consumption for OR 0495 rape seed oil, refined
3/ Consumption for CM 0081 bran, unprocessed of cereal grain

Maximum IESTI = 700

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)

CHLORMEQUAT (15) GENERAL POPULATION

Acute RfD: 0.05 mg/kg body weight

Code	Commodity Name	MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
GC 0640	Barley	2	0,15		1,8	6	NLD	63	378						1	0,0108	20
	Barley beer		0,0023	0.015		7,88	AUS	67	528						3	0,00002	0
	Barley pearl		0,009	0,06											3		
	Barley malt		0,1	0,69											3		
PE 0112	Eggs	0,1	0,04		0,064	3.51 1/	FRA	62,3	219						1	0,00022	0
MM 0814	Goat meat	0,2	0,04		0,11	7,34	USA	65	477						1	0,00081	2
MO 0098	Kidney of cattle/goats/pigs/sheep	0,5	0,084		0,35	12,12	USA	65	788						1	0,00424	8
MO 0099	Liver of cattle/goats/pigs/sheep	0,1	0,042		0,88	5,84	USA	65	380						1	0,00514	10
MM 0097	Meat of cattle, pigs and sheep	0,2	0,04		0,11	7,76	AUS	67	520						1	0,00085	2
ML 0107	Milk of cattle, goats and sheep	0,5	0,018			29,65	AUS	67	1987						3	0,00053	1
GC 0647	Oats	10	1,2		7,1	4,9	FRA	62,3	305						1	0,03479	70
	Oat flakes		0,25	0,21											3		
FP 0230	Pear	10	4,2		6,3	10,66	USA	65	693	100	FRA	89	89	7	2a	0,11891	240
PO 0111	Poultry, Edible offal of	0,1	0,0096		0,053	3.81	USA	65	248						1	0,00020	0
PM 0110	Poultry meat	0,04*	0		0	6,44	AUS	67	431						1	0	0
OC 0495	Rape seed oil, crude		0,037	0,018		0.97 2/	AUS	67	65						3	0,00020	0
GC 0650	Rye	3	0,26		2	1,22	NLD	63	77						1	0,00244	5
CM 0650	Rye bran, unprocessed	10	0,83	3,2		0.55 3/	AUS	67	37						3	0,00046	1
CF1250	Rye flour	3	0,26	0,99		1,84	FRA	62,3	115						3	0,00048	1
CF1251	Rye wholemeal	4	0,34	1,3		0,51	USA	65	33						3	0,00017	0
	Rye wholemeal bread		0,25	0,95											3		
GC 0653	Triticale	3	0,26		2										1		
GC 0654	Wheat	3	0,26		2	5,89	USA	65	383						1	0,01178	20
CM 0654	Wheat bran, unprocessed	10	0,94	2,6		1,23	USA	65	80						3	0,00116	2
CF1211	Wheat flour	2	0,11	0,41		1,34	USA	65	87						3	0,00015	0
CF1212	Wheat wholemeal	5	0,31	1,2		2,39	USA	65	155						3	0,00074	1
	Wheat wholemeal bread		0,18	0,71											3		

1/ Uses consumption for PE 0840, chicken eggs
2/ Uses consumption for OR 0495, rape seed oil, refined
3/ Uses consumption for CM 0081, bran, unprocessed of cereal grain

Maximum IESTI = 240

CHLORPYRIFOS (17) **INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)**
CHILDREN

Acute RfD: 0.10 mg/kg body weight

Code	Commodity Name	MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/ Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
TN 0660	Almonds	0,05	0,05		0,05	1,76	FRA	17,8	31						1	0,00009	0
FI 0327	Banana	2	0,01		0,05	19,61	JPN	15,9	312	150	FRA	68	102	7	2a	0,00291	3
VB 0400	Broccoli	2	0,02		1,40	10,95	USA	15	164	608	USA	78	474	5	2b	0,07665	80
VB 0041	Cabbages, Head	1	0,15		0,94	8,92	JPN	15,9	142	908	USA	79	717	5	2b	0,04192	40
VR 0577	Carrot	0,1	0,025		0,05	11,5	FRA	17,8	205	100	FRA	89	89	7	2a	0,00208	2
MO 1280	Cattle kidney	0,01	0,01		0,01	12,44	USA	15	187						1	0,00012	0
MO 1281	Cattle liver	0,01	0,01		0,01	11,39	FRA	17,8	203						1	0,00011	0
MM 0812	Cattle meat	1	0,02		0,02	12,52	AUS	19	238						1	0,00025	0
VB 0404	Cauliflower	0,05	0,01		0,02	12,31	NLD	17	209	1733	UNK	45	780	5	2b	0,00123	1
VL 0467	Chinese cabbage, " Pe-tsai"	1	0,18		0,60	11,49	JPN	15,9	183	840	USA	95	798	5	2b	0,03447	30
FC 0001	Citrus fruits (orange 1/)	2	0,08		0,40	34,14	UNK	14,5	495	131	USA	73	96	7	2a	0,02948	30
VP 0526	Common bean (pods/im. seed)	0,01	0,01		0,01	10,83	NLD	17	184						1	0,00011	0
SB 0716	Coffee	0,05	0,01	0,34	0,01	1,12	NLD	17	19						1	0,00002	0
DF 0269	Dried grapes	0,1	0,017		0,07	3,95	USA	15	59						1	0,00028	0
PE 0112	Eggs	0,01*	0,001		0,01	7,5	FRA	17,8	134						1	0,00008	0
FB 0269	Grapes	0,5	0,085		0,32	24,39	JPN	15,9	388	125	FRA	94	118	7	2a	0,02199	20
GC 0645	Maize	0,05	0,015			8,33	FRA	17,8	148						3	0,00012	0
OR 0645	Maize oil, edible	0,2	0,03	1,5		1,18	FRA	17,8	21						3	0,00004	0
ML 0107	Milk of cattle, goats & sheep	0,02	0,005			76,33	AUS	19	1450						3	0,00038	0
VA 0385	Onion, bulb	0,2	0,04		0,08	7,14	FRA	17,8	127	164	UNK	91	149	7	2b	0,00400	4
FS 0247	Peach	0,5	0,042		0,33	16,61	AUS	19	316	122	UNK	90	110	7	2a	0,01692	20
VP 0063	Peas (pod & succulent= im. seed)	0,01	0,01		0,01	3	JPN	15,9	48						1	0,00003	0
TN 0672	Pecan	0,05	0,05		0,05	1,17	AUS	19	22						1	0,00006	0
VO 0445	Peppers, sweet	2	0,38		1,40	3,16	AUS	19	60	119	USA	82	98	7	2b	0,03097	30
MO 0818	Pig, Edible offal of	0,01*	0		0,01	4,17	USA	15	63						1	0,00004	0
MM 0818	Pig meat	0,02	0,001		0,01	9,4	AUS	19	179						1	0,00009	0
FS 0014	Plums (including prunes)	0,5	0,04		0,20	14,29	FRA	17,8	254	59	UNK	94	55	7	2a	0,00660	7
FP 0009	Pome fruits (apple 1/)	1	0,17		0,94	45,25	USA	15	679	126	UNK	89	112	7	2a	0,08470	80
PM 0110	Poultry meat	0,01	0,001		0,01	11,78	AUS	19	224						1	0,00012	0

PO 0111	Poultry, Edible offal of	0,01*	0		0,01	2,47	USA	15	37						1	0,00002	0
MO 0822	Sheep, Edible offal of	0,01	0,01		0,01										1		
MM 0822	Sheep meat	1	0,02		0,02	23,53	FRA	17,8	419						1	0,00047	0
GC 0651	Sorghum flour	0,5	0,04												3		
FB 0275	Strawberry	0,3	0,09		0,15	9,28	AUS	19	176						1	0,00047	0
VR 0596	Sugar beet	0,05	0,015												3		
VO 0447	Sweet corn	0,01*	0,01		0,01	11,09	UNK	14,5	161	371	UNK	58	215	5	2b	0,00055	1
VO 0448	Tomato	0,5	0,13		0,33	10,6	USA	15	159	123	USA	100	123	7	2a	0,01973	20
VJ 0448	Tomato juice		0,026	0,2													
	Tomato paste		0,026	0,2													
TN 0678	Walnuts	0,05*	0,05		0,05	0,37	USA	15	6						1	0,00002	0
GC 0654	Wheat	0,5	0,015			10,07	USA	15	151						3	0,00015	0
CF 1211	Wheat flour	0,1	0,002	0,2		10,23	AUS	19	194						3	0,00002	0
CM 0654	Wheat bran, unprocessed		0,03	2,5		1,98	USA	15	30						3	0,00006	0
1/ Highest consumed commodity represents group when no groupconsumtion is available.																Maximum IESTI = 80	

CHLORPYRIFOS (17)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: 0.10 mg/kg body weight

Code	Commodity Name	MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/ Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
TN 0660	Almonds	0,05	0,05		0,05	1,4	JPN	52,6	74						1	0,00007	0
FI 0327	Banana	2	0,01		0,05	8,56	USA	65	556	150	FRA	68	102	7	2a	0,00090	1
VB 0400	Broccoli	2	0,02		1,40	5,79	USA	65	376	608	USA	78	474	5	2b	0,04053	40
VB 0041	Cabbages, head	1	0,15		0,94	5	FRA	62,3	312	908	USA	79	717	5	2b	0,02350	20
VR 0577	Carrot	0,1	0,025		0,05	5,32	NLD	63	335	100	FRA	89	89	7	2a	0,00069	1
MO 1280	Cattle, kidney	0,01	0,01		0,01	12,12	USA	65	788						1	0,00012	0
MO 1281	Cattle, liver	0,01	0,01		0,01	7,16	USA	65	465						1	0,00007	0
MM 0812	Cattle meat	1	0,02		0,02	6,97	AUS	67	467						1	0,00014	0
VB 0404	Cauliflower	0,05	0,01		0,02	8,26	UNK	70,1	579	1733	UNK	45	780	5	2b	0,00083	1
VL 0467	Chinese cabbage, "Pe-tsai"	1	0,18		0,60	5,8	USA	65	377	840	USA	95	798	5	2b	0,01740	20
FC 0001	Citrus fruits (grapefruit 1/)	2	0,08		0,40	18	JPN	52,6	947	256	USA	49	125	5	2a	0,01102	11
VP 0526	Common bean	0,01	0,01		0,01	6,84	NLD	63	431						1	0,00007	0

	(pods / im. seed)																
SB 0716	Coffee	0,05	0,01	0,34	0,01	1,04	NLD	63	66						1	0,00001	0
DF 0269	Dried grapes	0,1	0,017		0,07	2,17	FRA	62,3	135						1	0,00015	0
PE 0112	Eggs	0,01*	0,001		0,01	3,51	FRA	62,3	219						1	0,00004	0
FB 0269	Grapes	0,5	0,085		0,32	14,99	AUS	67	1004	125	FRA	94	118	7	2a	0,00816	8
GC 0645	Maize	0,05	0,015			4,17	FRA	62,3	260						3	0,00006	0
OR 0645	Maize oil, edible	0,2	0,03	1,5		0,68	NLD	63	43						3	0,00002	0
ML 0107	Milk of cattle, goats & sheep	0,02	0,005			29,65	AUS	67	1987						3	0,00015	0
VA 0385	Onion, bulb	0,2	0,04		0,08	4,91	FRA	62,3	306	164	UNK	91	149	7	2a	0,00154	2
FS 0247	Peach	0,5	0,042		0,33	16,16	AUS	67	1083	122	UNK	90	110	7	2a	0,00858	9
VP 0063	Peas (pod and succulent = im. seed)	0,01	0,01		0,01	1,19	JPN	52,6	63						1	0,00001	0
TN 0672	Pecan	0,05	0,05		0,05	0,35	AUS	67	23						1	0,00002	0
VO 0445	Peppers, sweet	2	0,38		1,40	3,33	FRA	62,3	207	119	USA	82	98	7	2a	0,01782	20
MO 0818	Pig, Edible offal of	0,01*	0		0,01	10,08	AUS	67	675						1	0,00010	0
MM 0818	Pig meat	0,02	0,001		0,01	4,87	NLD	63	307						1	0,00005	0
FS 0014	Plums (including prunes)	0,5	0,04		0,20	6,35	USA	65	413	59	UNK	94	55	7	2a	0,00229	2
FP 0009	Pome fruits (apple 1/)	1	0,17		0,94	20,74	USA	65	1348	126	UNK	89	112	7	2a	0,02923	30
PM 0110	Poultry meat	0,01	0,001		0,01	6,44	AUS	67	431						1	0,00006	0
PO 0111	Poultry, Edible offal of	0,01*	0		0,01	3,81	USA	65	248						1	0,00004	0
MO 0822	Sheep, Edible offal of	0,01	0,01		0,01	1,35	AUS	67	90						1	0,00001	0
MM 0822	Sheep meat	1	0,02		0,02	6,71	AUS	67	450						1	0,00013	0
GC 0651	Sorghum	0,5	0,04			0,27	USA	67	18						3	0,00001	0
FB 0275	Strawberry	0,3	0,09		0,15	5,55	FRA	62,3	346						1	0,00013	0
VR 0596	Sugar beet	0,05	0,015												3		
VO 0447	Sweet corn	0,01*	0,01		0,01	5,65	USA	65	367	371	UNK	58	215	5	2a	0,00019	0
VO 0448	Tomato	0,5	0,13		0,33	6,01	USA	65	391	123	USA	100	123	7	2a	0,00573	6
VJ 0448	Tomato juice		0,026	0,2													
	Tomato paste		0,026	0,2													
TN 0678	Walnuts	0,05*	0,05		0,05	2,18	FRA	62,3	136						1	0,00011	0
GC 0654	Wheat	0,5	0,015			5,89	USA	65	383						3	0,00009	0
CF 1211	Wheat flour	0,1	0,002	0,2		5,62	USA	65	365						3	0,00001	0
CM 0654	Wheat bran, unprocessed		0,03	2,5		1,23	USA	65	80						3	0,00004	0
1/ Highest consumed commodity represents group when no group consumption is available.															Maximum IESTI = 40		

DINOCAP (87)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
CHILDREN

Acute RfD: 0.030 mg/kg body weight

Code	Commodity Name	MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
FP 0226	Apple	0,2	0,05		0,09	45,25	USA	15	679	126	UNK	89	112	7	2a	0,00811	30
VC 0045	Fruiting vegetables,	0,05	0,05		0,05	77,51	AUS	19	1473	4518	USA	46	2078	5	2b	0,01938	60
	Cucurbits (watermelon 1/)																
FB 0269	Grapes	1	0,105		0,66	18	AUS	19	342	125	FRA	94	118	7	2a	0,03637	120
	Wine		0,007			0,21	AUS	19	4						3	0,00000	0
FB 0275	Strawberry	0,5	0,06		0,33	8,33	FRA	17,8	148						1	0,00275	9
FS 0247	Peach	0,1	0,05		0,09	16,16	AUS	19	307	110	FRA	90	99	7	2a	0,00427	10
VO 0051	Peppers	0,2	0,06		0,12	3,16	AUS	19	60	172	UNK	93	160	7	2b	0,00265	9
VO 0448	Tomato	0,3	0,045		0,18	10,6	USA	15	159	105	FRA	97	102	7	2a	0,00924	30
	1/ Highest consumed commodity represents group when no group consumption is available.														Maximum IESTI = 120		

DINOCAP (87)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
WOMEN OF CHILD-BEARING AGE

Acute RfD: 0.008 mg/kg body weight

Code	Commodity Name		MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
FP 0226	Apple		0,2	0,05		0,09	20,74	USA	65	1348	126	UNK	89	112	7	2a	0,00280	30
VC 0045	Fruiting vegetables,		0,05	0,05		0,05	29,83	USA	65	1939	4518	USA	46	2078	5	2b	0,00746	90
	Cucurbits (watermelon 1/)																	
FB 0269	Grapes		1	0,105		0,66	7,66	AUS	67	513	125	FRA	94	118	7	2a	0,01200	150
	Wine			0,007			16,88	AUS	67	1131						3	0,00012	1
FB 0275	Strawberry		0,5	0,06		0,33	5,55	FRA	62,3	346						1	0,00183	20
FS 0247	Peach		0,1	0,05		0,09	11,9	JPN	52,6	626	110	FRA	90	99	7	2a	0,00209	30

VO 0051	Peppers		0,2	0,06		0,12	3,33	FRA	62,3	207	172	UNK	93	160	7	2a	0,00225	30
VO 0448	Tomato		0,3	0,045		0,18	6,01	USA	65	391	105	FRA	97	102	7	2a	0,00217	30
1/ Highest consumed commodity represents group when no group consumption is available.																Maximum IESTI = 150		

DINOCAP (87)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION (EXCLUDING WOMEN OF CHILD-BEARING AGE)

Acute RfD: 0.030 mg/kg body weight

Code	Commodity Name	MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
FP 0226	Apple	0,2	0,050		0,09	20,74	USA	65	1348	126	UNK	89	112	7	2a	0,00280	9
VC 0045	Fruiting vegetables,	0,1	0,050		0,05	29,83	USA	65	1939	4518	USA	46	2078	5	2b	0,00746	20
	Cucurbits (watermelon 1/)																
FB 0269	Grapes	1	0,105		0,66	7,66	AUS	67	513	125	FRA	94	118	7	2a	0,01200	40
	Wine		0,007			16,88	AUS	67	1131						3	0,00012	0
FB 0275	Strawberry	0,5	0,060		0,33	5,55	FRA	62,3	346						1	0,00183	6
FS 0247	Peach	0,1	0,050		0,09	11,90	JPN	52,6	626	110	FRA	90	99	7	2a	0,00209	7
VO 0051	Peppers	0,2	0,060		0,12	3,33	FRA	62,3	207	172	UNK	93	160	7	2a	0,00225	7
VO 0448	Tomato	0,3	0,045		0,18	6,01	USA	65	391	105	FRA	97	102	7	2a	0,00217	7
	1/ Highest consumed commodity represents group when no group consumption is available.																

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FENTHION (39)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
CHILDREN

Acute RfD: 0.01 mg/kg bw

Code	Commodity Name	MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/ Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
CM 0649	Rice, husked	0,05	0,0145			12,5	FRA	17,8	223						3	0,00018	2

FENTHION (39)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERALPOPULATION

Acute RfD: 0.01 mg/kg bw

Code	Commodity Name	MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/ Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
CM 0649	Rice, husked	0,05	0,0145			6,07	JPN	52,6	319						3	0,00009	1

MALATHION (49)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
CHILDREN

Acute RfD: not yet established

Code	Commodity Name		MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/ Food large portion g/kg bw	Country of high consumption Body weight	kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
CF 1211	Wheat flour		0,2	0,0092	0,23		10,23	AUS	19	194						3	0,00009	-

MALATHION (49)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: not yet established

Code	Commodity Name		MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/ Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
CF 1211	Wheat flour		0,2	0,0092	0,23		5,62	USA	65	365						3	0,00005	-

PARATHION (58)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
CHILDREN

Acute RfD: 0.01 mg/kg bw

Code	Commodity Name		MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/ Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
FP 0226	Apple		0,2	0,025		0,16	45,25	USA	15	679	110	FRA	91	100	7	2a	0,01365	140
	Apple juice			0,0018	0,072													
GC 0640	Barley		7	1,95		5,1	0,73	AUS	19	14						1	0,00372	40
GC 0645	Maize		0,1	0,05		0,09	8,33	FRA	17,8	148								
	Maize grits			0,05	0,99													
CF 0645	Maize meal			0,037	0,74	0,07												
CF 1255	Maize flour		0.1	0,034	0,68		3,16	AUS	19	60						3	0,00011	1
OR 0645	Maize oil, edible		0.3	0,12	2,4		1,18	FRA	17,8	21						3	0,00014	1
GC 0652	Sorghum		5	1,06		4,2										1		
	Sorghum bran			2,0	1,9													
	Sorghum grits			0,49	0,46													
	Sorghum flour			0,42	0,4													
VD 0541	Soya bean (dry)		0,05*	0,05		0,05	5,55	JPN	15,9	88						1	0,00028	3
SO 0702	Sunflower seed		0,05*	0,05		0,05	1,59	USA	15	24						1	0,00008	1
OR 0702	Sunflower seed oil, edible		0.05*	0,021	0,42		2,08	FRA	17,8	37						3	0,00004	0
VO 0447	Sweet corn (corn-on-the-cob)		0,05*	0,05		0,05	11,09	UNK	14,5	161	371	UNK	58	215	5	2b	0,00277	30
GC 0654	Wheat		1	0,125		0,96	10,07	USA	15	151								
CM 0654	Wheat bran, unprocessed			0,58	4,6		0,67	AUS	19	13						3	0,00039	4
CF 1211	Wheat flour			0,044	0,35		10,23	AUS	19	194						3	0,00045	5

PARATHION (58)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: 0.01 mg/kg bw

Code	Commodity Name		MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/ Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
FP 0226	Apple		0,2	0,025		0,16	20,74	USA	65	1348	110	FRA	91	100	7	2a	0,00480	50
	Apple juice			0,0018	0,072													
GC 0640	Barley		7	1,95		5,1	7,88	AUS	67	528						1	0,04019	400
GC 0645	Maize		0,1	0,05		0,09						See maize commodities						
	Maize grits			0,05	0,99													
CF 0645	Maize meal			0,037	0,74	0,07												
CF 1255	Maize flour		0.1	0,034	0,68		1,34	AUS	67	89,78						3	0,00005	0
OR 0645	Maize oil, edible		0.3	0,12	2,4		0,68	NLD	63	43						3	0,00008	1
GC 0652	Sorghum		5	1,06		4,2	0,27	USA	65	18						1	0,00113	10
	Sorghum bran			2,0	1,9													
	Sorghum grits			0,49	0,46													
	Sorghum flour			0,42	0,4													
VD 0541	Soya bean (dry)		0,05*	0,05		0,05	3,33	JPN	52,6	175						1	0,00017	2
SO 0702	Sunflower seed		0,05*	0,05		0,05	2,97	USA	65	193						1	0,00015	1
OR 0702	Sunflower seed oil, edible		0,05*	0,021	0,42		0,98	FRA	62,3	61						3	0,00002	0
VO 0447	Sweet corn (corn-on-the-cob)		0,05*	0,05		0,05	5,65	USA	65	367	371	UK	58	215	5	2a	0,00094	9
GC 0654	Wheat		1	0,125		0,96						See wheat bran and flour						
CM 0654	Wheat bran, unprocessed			0,58	4,6		0,55	AUS	67	37						3	0,00032	3
CF 1211	Wheat flour			0,044	0,35		5,62	USA	65	365						3	0,00025	2
																	Maximum IESTI = 400	

PARATHIONMETHYL (59)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
CHILDREN

Acute RfD: 0.03 mg/kg bw

	Commodity	MRL	STMR or STMR-P	Processing factor	HR or HR-P	GEMS/ Food large portion	Country of high consumption	Body weight	Per capita large portion	Unit weight	Country of unit weight	Percent edible portion	Unit weight, edible portion	Variability factor	Case	IESTI	Percent acute RfD
Code	Name	mg/kg	mg/kg		mg/kg	g/kg bw		kg	g/person	g		%	g			mg/kg bw	%
FP 0226	Apple	0,2	0,06		0,18	45,25	USA	15	679	110	FRA	91	100	7	2a	0,01535	50
	Apple juice		0,0015	0,25				15							3		
VD 0071	Beans (dry)	0,05*	0,05		0,05	11,76	FRA	17,8	209						1	0,00059	2
VB 0041	Cabbages, head	0,05	0,05		0,26	8,92	JPN	15,9	142	908	USA	79	717	5	2b	0,01160	40
OR 0691	Cotton seed oil, edible	10	1,16	0,33		0,41	USA	15	6						3	0,00048	2
DF 0269	Dried grapes (= Currants,	1	0,14	1,4	0,70	3,95	USA	15	59						1	0,00277	9
	Raisins and Sultanas																
FB 0269	Grapes	0,5	0,10		0,41	18	AUS	19	342	125	FRA	94	118	7	2a	0,02259	80
GC 0645	Maize	0,1	0,05		0,09	8,33	FRA	17,8	148		see maize flour						
CF 1255	Maize flour	0,05	0,021	0,41		3,16	AUS	19	60						3	0,00007	0
OR 0645	Maize oil, edible	0,1	0,051	1,03		1,18	FRA	17,8	21						3	0,00006	0
FS 0247	Peach	0,3	0,095		0,22	16,16	AUS	19	307	110	FRA	90	99	7	2a	0,01043	30
VD 0072	Peas (dry)	0,3	0,06		0,24	6	FRA	17,8	107						1	0,00144	5
VR 0589	Potato	0,05*	0		0	19,23	UNK	14,5	279	122	USA	81	99	7	2a	0,00000	0
OR 0495	Rape seed oil, edible	0,2	0,10	2		0,97	AUS	19	18						3	0,00010	0
GC 0654	Wheat	5	0,29		4,10	10,07	USA	15	151		see wheat bran and flour						
CM 0654	Wheat bran, unprocessed	10	0,64	2,2		0,67	AUS	19	13						3	0,00043	1
CF 1211	Wheat flour	2	0,11	0,39		10,23	AUS	19	194						3	0,00113	4
																Maximum IESTI =	80

PARATHION-METHYL (59)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: 0.03 mg/kg bw

Code	Commodity Name	MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/ Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
FP 0226	Apple	0,2	0,06		0,18	20,74	USA	65	1348	110	FRA	91	100	7	2a	0,00540	20
	Apple juice		0,0015	0,25											3		
VD 0071	Beans (dry)	0,05*	0,05		0,05	4,1	FRA	62,3	255						1	0,00021	1
VB 0041	Cabbages, Head	0,05	0,05		0,26	5	FRA	62,3	312	908	USA	79	717	5	2b	0,00650	20
OR 0691	Cotton seed oil, edible	10	1,16	0,33		0,41	USA	15	6						3	0,00048	2
DF 0269	Dried grapes (= Currants,	1	0,14	1,4	0,70	2,17	FRA	62,3	135						1	0,00152	5
	Raisins and Sultanas)																
FB 0269	Grapes	0,5	0,1		0,41	7,66	AUS	67	513	125	FRA	94	118	7	2a	0,00745	20
GC 0645	Maize	0,1	0,05		0,09	4,17	FRA	62,3	260		see maize flour						
CF 1255	Maize flour	0,05	0,021	0,41		1,34	AUS	67	90						3	0,00003	0
OR 0645	Maize oil, edible	0,1	0,051	1,03		0,68	NLD	63	43						3	0,00003	0
FS 0247	Peach	0,3	0,095		0,22	11,9	JPN	52,6	626	110	FRA	90	99	7	2a	0,00510	20
VD 0072	Peas (dry)	0,3	0,06		0,24	7,14	FRA	62,3	445						1	0,00171	6
VR 0589	Potato	0,05*	0		0,00	10,9	NLD	63	687	122	USA	81	99	7	2a	0,00000	0
OR 0495	Rape seed oil, edible	0,2	0,1	2		0,97	AUS	67	65						3	0,00010	0
GC 0654	Wheat	5	0,29		4,10	5,89	USA	65	383		see wheat bran and flour						
CM 0654	Wheat bran, unprocessed	10	0,64	2,2		0,55	AUS	67	37						3	0,00035	1
CF 1211	Wheat flour	2	0,11	0,39		5,62	USA	65	365						3	0,00062	2
																Maximum IESTI =	20

PYRETHRINS (63)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
CHILDREN AGES 6 AND UNDER

Acute RfD: 0.2 mg/kg bw

	Commodity		MRL	STMR or STMR-P	Processing factor	HR or HR-P	GEMS/ Food large portion	Country of high consumption	Body weight	Per capita large portion	Unit weight	Country of unit weight	Percent edible portion	Unit weight, edible portion	Variability factor	Case	IESTI	Percent acute RfD
Code	Name		mg/kg	mg/kg		mg/kg	g/kg bw		kg	g/person	g		%	g			mg/kg bw	%
FC 0001	Citrus fruits (grapefruit 1/)		0,05	0,04	1	0,0	34,14	UNK	14,5	495	131	USA	73	96	7	2a	0,00295	1
DF 0167	Dried fruits		0,2	0,05	1	0,110	5,67	FRA	17,8	101						1	0,00062	0
VC 0045	Fruiting vegetables, curcubits		0,05*	0,04	1	0,04	77,51	USA	15	1163	4518	USA	46	2078	5	2b	0,01550	8
	(watermelon 1/)																	
SO 0697	Peanut		0,5	0,05	1	0,23	5,18	USA	15	78						1	0,00119	1
VO 0051	Peppers		0,05*	0,04	1	0,04	3,16	AUS	19	60	119	USA	82	98	7	2b	0,00088	0
VD 0070	Pulses (peas (dry) 1/)		0,1	0,05	1	0,0500	11,76	FRA	17,8	209						1	0,00059	0
VR 0075	Root and tuber vegetables		0,05*	0	1	0,0400	19,23	UNK	14,5	279	122	USA	81	99	7	2a	0,00240	1
	(potato 1/)																	
VO 0448	Tomato		0,05*	0,04	1	0,0400	10,6	USA	15	159	123	USA	100	123	7	2a	0,00239	1
VJ 0448	Tomato juice			0,018	0,45		2/											
	Tomato puree			0,018	0,45		2/											
																	Maximum IESTI =	8
	1/ Highest consumed commodity represents group when group consumption is not available																	
	2/ High consumption data not available																	

PYRETHRINS (63)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
CHILDREN AGES 6 AND UNDER

Acute RfD: 0.2 mg/kg bw

Code	Commodity Name	MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/ Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
FC 0001	Citrus fruits (grapefruit 1/)	0,05	0,04	1	0,0	34,14	UNK	14,5	495	131	USA	73	96	7	2a	0,00295	1
DF 0167	Dried fruits	0,2	0,05	1	0,110	5,67	FRA	17,8	101						1	0,00062	0
VC 0045	Fruiting vegetables, curcubits	0,05*	0,04	1	0,04	77,51	USA	15	1163	4518	USA	46	2078	5	2b	0,01550	8
	(watermelon 1/)																
SO 0697	Peanut	0,5	0,05	1	0,23	5,18	USA	15	78						1	0,00119	1
VO 0051	Peppers	0,05*	0,04	1	0,04	3,16	AUS	19	60	119	USA	82	98	7	2b	0,00088	0
VD 0070	Pulses (peas (dry) 1/)	0,1	0,05	1	0,0500	11,76	FRA	17,8	209						1	0,00059	0
VR 0075	Root and tuber vegetables	0,05*	0	1	0,0400	19,23	UNK	14,5	279	122	USA	81	99	7	2a	0,00240	1
	(potato 1/)																
VO 0448	Tomato	0,05*	0,04	1	0,0400	10,6	USA	15	159	123	USA	100	123	7	2a	0,00239	1
VJ 0448	Tomato juice		0,018	0,45		2/											
	Tomato puree		0,018	0,45		2/											
																Maximum IESTI =	8
	1/ Highest consumed commodity represents group when group consumption is not available																
	2/ High consumption data not available																

THIABENDAZOLE (65)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
CHILDREN

Acute RfD: not yet established

	Commodity		MRL	STMR or STMR-P	Processing factor	HR or HR-P	GEMS/ Food large portion	Country of high consumption	Body weight	Per capita large portion	Unit weight	Country of unit weight	Percent edible portion	Unit weight, edible portion	Variability factor	Case	IESTI	Percent acute RfD
Code	Name		mg/kg	mg/kg		mg/kg	g/kg bw		kg	g/person	g		%	g			mg/kg bw	%
FI 0326	Avocado		15	0,9		1,8	8,7	USA	15	131	201	USA	75	151	7	2b	0,10962	-
FI 0327	Banana		5	0,029		0,031	19,61	JPN	15,9	312	150	FRA	68	102	7	2a	0,00180	-
ML 0812	Cattle milk		0,2	0,12			76,33	AUS	19	1450						3	0,00916	-
MM 0812	Cattle meat		0,1	0,02		0,02	12,52	AUS	19	238						1	0,00025	-
MO 1280	Cattle kidney		1	0,5		0,6	12,44	USA	15	187						1	0,00746	-
MO 1281	Cattle liver		0,3	0,2		0,21	11,39	FRA	17,8	203						1	0,00239	-
FC 0001	Citrus fruits (oranges 1/)		3	0,1		0,09	34,14	UNK	14,5	495	131	USA	73	96	7	2a	0,00663	-
MO 0096	Edible offal of goats, pigs		0,1	0,1		0,1	11,39	FRA	17,8	203						1	0,00114	-
	and sheep (except cattle and horses) 2/																	
PE 112	Eggs (chicken eggs 1/) 2/		0,1	0,1		0,1	7,5	FRA	17,8	134						1	0,00075	-
ML 0814	Goat milk		0,1	0,1			19,55	AUS	19	371						3	0,00196	-
FI 0345	Mango		5	2,85		4,6	10,9	AUS	19	207	207	USA	67	139	7	2a	0,25161	-
MM 0096	Meat of goats, pigs		0,1	0,1		0,1	13,72	AUS	19	261						1	0,00137	-
	and sheep (except cattle and horses) 2/																	
VC 0046	Melon, except watermelon		1	0,43		0,82	21,74	AUS	19	413	1000	USA	63	630	5	2b	0,08913	-
VO 0450	Mushroom		60	31		52	4	FRA	17,8	71						1	0,20800	-
FI 0350	Papaya		10	3,8		5,1	16,01	USA	15	240	304	USA	67	204	5	2a	0,35866	-
FP 0009	Pome fruits (apple 1/)		3	1,7		2,0	45,25	USA	15	679	138	USA	92	127	7	2a	0,19207	-
VR 0589	Potato		15	5,4	0,2	11	19,23	UNK	14,5	279	188	UNK	85	160	7	2a	0,93890	-
PM 0110	Poultry meat 2/		0,05	0,05		0,05	11,78	AUS	19	224				0		1	0,00059	-
FB 0275	Strawberry		5	1,6		2,7	9,28	AUS	19	176						1	0,02506	-
VS 0469	Witloof chicory (sprouts)		0,05	0,05		0,05	10,6	NLD	17	180				0		1	0,00053	-
	1/ Highest consumed commodity represents group when no group consumption is available.																	
	2/ Residues of thiabendazole arising from veterinary use. MRL is used in lieu of HR.																	

THIABENDAZOLE (65)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: not yet established

Code	Commodity Name		MRL mg/kg	STMR or STMR-P mg/kg	Processing factor	HR or HR-P mg/kg	GEMS/ Food large portion g/kg bw	Country of high consumption	Body weight kg	Per capita large portion g/person	Unit weight g	Country of unit weight	Percent edible portion %	Unit weight, edible portion g	Variability factor	Case	IESTI mg/kg bw	Percent acute RfD %
FI 0326	Avocado		15	0,9		1,8	4,17	FRA	62,3	260	201	USA	75	151	7	2a	0,03364	-
FI 0327	Banana		5	0,029		0,031	8,56	USA	65	556	150	FRA	68	102	7	2a	0,00056	-
ML 0812	Cattle milk		0,2	0,12			39,92	NLD	63	2515						3	0,00479	-
MM 0812	Cattle meat		0,1	0,02		0,02	6,97	AUS	67	467						1	0,00014	-
MO 1280	Cattle kidney		1	0,5		0,6	12,12	USA	65	788						1	0,00727	-
MO 1281	Cattle liver		0,3	0,2		0,21	7,16	USA	65	465						1	0,00150	-
FC 0001	Citrus fruits (grapefruit 1/)		3	0,1		0,09	18	JPN	52,6	947	256	USA	49	125	5	2a	0,00248	-
MO 0096	Edible offal of goats, pigs		0,1	0,1		0,1	4,44	FRA	62,3	277						1	0,00044	-
	and sheep (except cattle and horses) 2/																	
PE 0112	Eggs (chicken eggs 1/) 2/		0,1	0,1		0,1	3,51	FRA	62,3	219						1	0,00035	-
ML 0814	Goat milk		0,1	0,1			11,04	AUS	67	740						3	0,00110	-
FI 0345	Mango		5	2,85		4,6	9,1	FRA	62,3	567	207	USA	67	139	7	2a	0,10330	-
MM 0096	Meat of goats, pigs		0,1	0,1		0,1	7,60	AUS	67	509						1	0,00076	-
	and sheep (except cattle and horses) 2/																	
VC 0046	Melon, except watermelon		1	0,43		0,8	10,08	USA	65	655	1000	USA	63	630	5	2a	0,04006	-
VO 0450	Mushroom		60	31		52,0	3,51	FRA	62,3	219						1	0,18252	-
FI 0350	Papaya		10	3,8		5,1	8,72	USA	65	567	304	USA	67	204	5	2a	0,10840	-
FP 0009	Pome fruits (apple 1/)		3	1,7		2,0	20,74	USA	65	1348	138	USA	92	127	7	2a	0,06492	-
VR 0589	Potato		15	5,4	0,2	11,0	10,9	NLD	63	687	188	UNK	85	160	7	2a	0,28731	-
PM 0110	Poultry meat 2/		0,05	0,05		0,05	6,44	AUS	67	431						1	0,00032	-
FB 0275	Strawberry		5	1,6		2,7	5,55	FRA	62	346						1	0,01499	-
VS 0469	Witloof chicory (sprouts)		0,05	0,05		0,05	6,79	NLD	63	428						1	0,00034	-
	1/ Highest consumed commodity represents group when no group consumption is available.																	
	2/ Residues of thiabendazole arising from veterinary use. MRL is used in lieu of HR.																	

Annex 5

Proposed test guideline – single-dose toxicity study by the oral route (for use in establishing acute reference doses for chemical residues in food and drinking-water)

A. Background

Dietary intake of a substance in food or drinking-water may occur over a short period of time, e.g. during a single meal or over one day. Such a situation may arise when pesticide residues remaining on treated agricultural commodities are consumed. Sometimes the toxicological profile of the chemical raises concern about the potential risk – particularly to infants and children – following the intake of such residues. As a matter of standard practice in the risk assessment of residues in food and drinking-water, the case for establishing an acute reference dose (acute RfD)[1] should be considered for all compounds. The decision to proceed, however, must be made on a case-by-case basis.

The study described herein would be conducted only after it has been determined from the existing toxicological database that acute effects may occur. The study would be tailored to include the evaluation of endpoints that have been identified as targets in acceptable repeated-dose and other key studies with the test substance. This targeted approach would assure the greatest efficiency in study design and execution, and would reflect refinement of the use of animals and other resources.

Several categories of toxicological alerts have been identified that support the need to establish an acute RfD. They include:

1. Acute oral lethality or LD_{50} data

2. Developmental effects, except when these are clearly the consequence of maternal toxicity;

3. Clinical signs observed early in repeated dose studies (e.g. acute neurobehavioral effects or effects on the gastrointestinal, cardiovascular, or respiratory systems);

4. Acute neurotoxicity, including that deriving from exposure to organophosphorus and carbamate insecticides;

5. Hormonal or other biochemical alterations observed in repeated-dose studies, which might conceivably be elicited by a single dose.

B. Purpose

This study provides information on the possible health hazards that may arise following single exposure to the test substance. Data from the study provide information useful for the establishment of an acute RfD to be used in estimating acute dietary risk for infants, children, and other members of the population.

The test method incorporates relevant elements of the acute neurotoxicity screening battery and of the basic repeated-dose toxicity studies in rodents and non-rodents (i.e. 28-day, 90-day and long-term studies) that may be used for chemicals when such information is needed to understand the consequences of

[1] The acute reference dose is defined as "the estimate of the amount of a substance in food or drinking-water, expressed on a milligram per kilogram body weight basis, that can be ingested over a short period of time, usually during one meal or one day, without appreciable health risk to the consumer on the basis of all the known facts at the time of the evaluation" (WHO, 1997).

longer-term intake. It includes administration of single doses of the chemical at multiple dose levels that are either minimally toxic or at the no-observed-adverse-effect level (NOAEL). The goal of the study is to identify the most appropriate NOAEL to which safety factors are applied to derive an acute RfD.

C. Principle of the Test

The test substance is orally administered as a single dose to several groups of experimental animals, one dose level per group. A control group is also maintained. The animals are followed closely each day for signs of toxicity, with termination at 14 days after treatment; an interim group should be killed at 24 hours. Animals that die or are killed during the test are necropsied and, at the conclusion of the test period (24 hours and 14 days), the remaining animals in each respective group are killed.

D. Description of the method

1. Selection of animal species

   a. Rodent – The preferred rodent species is the rat, although occasionally the mouse may be more sensitive or a better model for humans. Commonly used strains of healthy animals should be employed. Females should be nulliparous and non-pregnant. When adult animals are used, dosing should occur when the animals are between 8 and 10 weeks of age. There may be circumstances, however, in which it is desirable to determine if age-related differences in sensitivity of response to the substance exist. In this case, more than one group of animals should be studied – one group that is treated at age 8-10 weeks, the other(s) that is treated at one or more time periods earlier in postnatal life. The weight variation of the animals used should be minimal at commencement of the study and should not exceed $\pm$ 20% of the mean weight of each sex. The animals used in this study should preferably be from the same strain and source as those animals used in the repeated-dose and other key studies that make up the toxicological database for the test substance.

   If the existing toxicological database including, at a minimum, a 90-day short-term repeated dose study, indicates that the dog (or mouse) is significantly more sensitive than the rat, and no other information exists to indicate which species is more appropriate for human health hazard assessment, then groups of dogs or mice may be used. If the mouse is the preferred rodent species, the principles employed for the rat should be applied.

   b. Non-rodent – If the dog is identified as the species of choice, a defined breed should be selected; the beagle is frequently used. Young adult animals should be used. Dosing should commence after a period of acclimation (at least 5 days is recommended), preferably at 4-6 months of age, but not later then 9 months of age. At commencement of the study, the weight variation of the animals should be minimal and not exceed $\pm$ 20% of the mean weight of each sex. Females should be nulliparous and non-pregnant.

2. Housing and feeding conditions

   a. Rodents – The temperature in the experimental animal room should be 22 $\pm$ 3 degrees C. Although the relative humidity should be at least 30% and preferably not above 70% other than during room cleaning, the aim should be 50-60%. Lighting should be artificial, the sequence being 12 hours light, 12 hours dark. Conventional laboratory diets may be used, with an unlimited supply of drinking-water. Rodents may be housed individually, or be caged in small groups of the same sex; for group caging, no more than five animals should be housed per cage.

   b. Dogs – It is recommended that each animal be caged individually. In any case, the number of animals per cage must not interfere with a clear observation of each animal. Conventional laboratory diets may be used, with an unlimited supply of drinking-water.

3. Preparation of animals

In the standard study, healthy young adult animals are randomly assigned to the control and treatment groups. Cages should be arranged in such a way that possible effects due to cage placement are minimized. The animals are identified uniquely and kept in their cages for at least 5 days prior to the start of the study to allow for acclimatization to the laboratory conditions.

When the standard study is expanded to evaluate pre-weaning exposure, the animals (dams and offspring) must be handled in a manner consistent with OECD TG 416 (multigeneration reproductive toxicity study).

4. Preparation of doses

a. The test compound (and control vehicle, if one is needed) is administered by gavage to the rodent, by capsule to the dog. The animals should not be fasted.

b. When necessary, the test substance is dissolved or suspended in a suitable vehicle. It is recommended that, wherever possible, the use of an aqueous solution be considered first, followed by consideration of a solution/emulsion in oil (e.g., corn oil) and then by solution on other vehicles. For vehicles other than water, the toxic characteristics of the vehicle must be known. The homogeneity of the test substance in the vehicle should be assured.

E. Procedure

1. Number and sex of animals

a. Rodent – At least 20 animals (ten males and ten females) should be used at each dose level, including the control group. A minimum of ten animals per sex per dose group should be used for the 24-hour evaluation. A minimum of five males and five females from each dose level should be used for the 14-day post-treatment evaluation.

b. Dog – At least 8 animals (four males and four females) should be used at each dose level, including the control group. A minimum of four animals per sex per dose group should be used for the 24-hour evaluation. At least two males and two females from each dose level should be used for the 14-day post-treatment evaluation.

[If existing data show that one sex is *clearly and consistently* more sensitive than the other, the study design may be modified to test only in that sex, with the attendant reduction in the total number of animals required.]

2. Dose selection

a. Generally, three test groups and a control group should be used. Dose levels should be selected taking into account any existing toxicity and (toxico-) kinetic data available for the test compound or related materials. At a minimum, results from a 90-day short-term repeated-dose toxicity study should be available. Results from prenatal developmental and multigeneration reproductive toxicity studies would also be useful in dose selection. The highest dose should be chosen with the aim of inducing toxic effects, but not death or severe suffering. Thereafter, a descending sequence of dose levels should be selected with a view to demonstrating any dose-related response and identifying a NOAEL at the lowest dose.

b. Except for treatment with a vehicle instead of the test substance, the animals in the control group should be handled in an identical manner to the test group subjects. The control group should receive the vehicle in the highest volume used if a vehicle is used in administering the test substance.

c. When there is evidence in repeated-dose studies that the toxicodynamic effect of the test substance is cumulative (e.g. irreversible inhibition of acetylcholinesterase activity), the use of a split-dose regimen (i.e. two or three dose increments over 24 hours) may be appropriate.

3. Administration of the test compound

The test substance is administered by gavage to non-fasted rodents. This should be done in a single dose to the animals using a stomach tube or a suitable intubation cannula. The maximum volume of liquid that can be administered at one time depends upon the size of the test animal. The volume should not exceed 1 ml/100g body weight, except in the case of aqueous solutions where 2 ml/100g bw may be used. Except for irritating or corrosive substances that will normally reveal exacerbated effects with higher concentrations, variability in volume should be minimized by adjusting the concentration to ensure a constant volume at all dose levels.

With dogs, the test substance should be administered in gelatin capsules.

4. Observations

a. The observation period should be up to 14 days. Animals in the interim sacrifice group will be terminated at 24 hours.

b. General observations should be made at least once a day, preferably at the same time(s) each day. The health condition of the animals should be recorded. All animals are observed for morbidity and mortality at least twice daily.

c. Detailed clinical observations on all animals should be made before administration of the test substance (to account for within-animal comparisons) and at specific times thereafter. Full clinical evaluations should occur at the time of peak effect and 0.5, 1, 2, 4 and 24 hours after dosing. The 14-day subgroup should have clinical observations carried out on them daily after the first 24 hours. These observations should be made outside the home cage in a standard arena and preferably at the same time each day. They should be carefully recorded, preferably using scoring systems explicitly defined by the testing laboratory. Effort should be made to ensure that variations in the test conditions are minimal and that observations are preferably conducted by observers unaware of the treatment. Signs noted should include, but not be limited to, changes in skin, fur, eyes, mucous membranes, occurrence of secretions and excretions and autonomic activity (e.g., lacrimation, piloerection, pupil size, unusual respiratory pattern). Changes in gait, posture, and response to handling as well as the presence of clonic or tonic movements, stereotypies (e.g. excessive grooming or repetititive circling) or bizarre behavior (e.g., self-mutilation or walking backwards) should also be recorded.

d. Functional observations.

(1) If the rat is used, sensory reactivity to stimuli of different types (e.g. auditory, visual and proprioceptive stimuli), grip strength, and motor activity should be assessed unless existing data from acceptable repeated-dose studies *definitively* indicate that these parameters are not affected by the test substance. Additional discussion of parameters that may be included in this evaluation can be found in the guideline for the Neurotoxicity Screening Battery guideline.

(2) The evaluation should be conducted at the following times: At estimated time of peak effect, 24 hours after treatment in all animals (i.e. just before termination of the 24-hour treatment group and at 14 days (i.e., just before termination of the 14-day treatment group).

(3) The elements described in this guideline may be combined with the acute neurotoxicity screening battery study, as long as none of the requirements of either are violated by the combination.

6. Body weight and food/water consumption
All animals should be weighed on the day of treatment and daily thereafter. Measurements of food consumption and drinking-water intake should be made daily for the first week, and at the end of the study at 14 days.

7. Haematology
   a. Unless existing data from acceptable repeated dose studies with the test substance *definitively* indicate that the haematopoetic system is not a target site, the following haematological parameters should be examined at the end of the test period: haematocrit, haemoglobin concentration, erythrocyte count, total and differential leukocyte count, platelet count, and a measure of blood clotting time/potential.

   b. Blood samples should be taken from a named site just prior to or as part of the procedure for killing the animals, and stored under appropriate conditions.

8. Clinical biochemistry
   a. Clinical biochemistry determinations to investigate major toxic effects in tissues, and specifically, effects on kidney and liver, should be performed on blood samples of all animals just prior to or as part of the procedure for killing the animals (apart from those found moribund and/or intercurrently killed). Overnight fasting of the animals prior to blood sampling is recommended. Unless existing data from acceptable repeated-dose studies with the test substance *definitively* indicate that the parameter is not affected by the test substance, the following investigations of plasma or serum shall include: sodium, potassium, chloride, glucose, total cholesterol, urea, creatinine, total protein and albumin, at least two enzymes indicative of hepatocellular effects (such as alanine amintransferase, aspartate aminotransferase, alkaline phosphatase, gamma glutamyl transpeptidase, and sorbitol dehydrogenase). Measurements of additional enzymes (of hepatic or other origin) and bile acids may provide useful information under certain circumstances.

   b. Urinalysis determinations should be performed at the end of the study, using timed urine volume collection. Unless existing data from acceptable repeated dose studies with the test substance *definitively* indicate that the parameter is not affected by the test substance, the following parameters should be evaluated: appearance, volume, osmolality or specific gravity, pH, protein, glucose, blood and blood cells.

   c. In addition, studies to investigate serum markers of general tissue damage should be considered. Other determinations that should be carried out if the known properties of the test substance may, or are suspected to, affect related metabolic profiles include: calcium, phosphate, fasting triglycerides, specific hormones, blood methaemoglobin and cholinesterase(s). These need to be identified for chemicals in certain classes or on a case-by-case basis.

   d. If a specific effect of the test substance has been observed using special techniques in other studies, then these techniques should also be used in this study. For instance, cholinesterase inhibition in plasma, red blood cells, brain and peripheral nervous tissue should be measured for compounds known to inhibit these enzymes.

   e. Consideration should be given to determination of hematological and clinical biochemistry variables before dosing begins.

9. Ophthalmological examination – If the test species is the dog, an ophthalmological examination, using an ophthalmoscope or equivalent suitable equipment, should be made on all animals prior to administration of the test substance and at termination of the study, preferably in all animals, but at least in the high-dose and control groups. If changes in the eyes are detected, all animals in the other dose groups should be examined.

10. Pathology
    a. Gross necropsy
        (1) All animals in the study shall be subjected to a full, detailed gross necropsy that includes careful examination of the external surface of the body, all orifices, and the cranial, thoracic and abdominal cavities and their contents. Unless existing data from acceptable repeated-dose studies with the test substance *definitively* indicate that the tissue is not affected by the test substance, the liver, kidneys, adrenals, testes, epididymides, ovary, uterus, thymus, spleen, brain and heart of all animals (apart from those found moribund and/or intercurrently killed) should be trimmed of any adherent tissue, as appropriate, and their wet weight taken as soon as possible after dissection to avoid drying.

        (2) Unless existing data from acceptable repeated-dose studies *definitively* indicate that the tissue is not affected by the test substance, the following tissues should be preserved in the most appropriate fixation medium for both the type of tissue and the intended subsequent histopathological examination: all gross lesions, brain (representative regions including cerebrum, cerebellum and pons), spinal cord, stomach, small and large intestines (including Peyer's patches), liver, kidneys, adrenals, spleen, heart, thymus, thyroid, trachea and lungs (preserved by inflation with fixative and then immersion),ovaries, testes, epididymides, accessory sex organs (e.g., prostate, seminal vesicles), ovary and uterus, urinary bladder, lymph nodes (preferably one lymph node covering the route of administration and another one distant from the route of administration to cover systemic effects), peripheral nerve (sciatic or tibial) preferably in close proximity to the muscle, eye and a section of bone marrow (or, alternatively, a fresh mounted bone marrow aspirate). The clinical and other findings may suggest the need to examine additional tissues. Also, any organs considered likely to be target organs based upon the known properties of the test substance should be preserved.

    b. Histopathology
        (1) Unless existing data from acceptable repeated-dose studies *definitively* indicate that the tissue is not affected by the test substance, full histopathological examinations should be carried out on the preserved organs and tissues of all animals in the control and high dose groups of the main study and the satellite interim sacrifice groups. These examinations should be extended to animals of all other dosage groups, if treatment-related changes are observed in the highest-dose group.

        (2) All gross lesions shall be examined.

F. Data and reporting

1. Individual animal data should be provided. Additionally, all data should be summarized in tabular form showing, for each test group, the number of animals at the start of the test, the number of animals found dead during the test or killed for humane reasons and the time of death or humane kill, the number showing signs of toxicity, a description of the signs of toxicity observed, including time of onset, duration, and severity of any toxic effects, the

number of animals showing lesions, the type of lesions and the percentage of animals displaying each type of lesion.

2. When possible, numerical results should be evaluated by an appropriate and generally acceptable statistical method. The statistical method should be selected during the design of the study.

G. Test report

The test report must include the following information:

1. Rationale for specific study design- (e.g. choice of species and sex, dose selection, end-point selection)

2. Test substance
   a. Physical nature, purity and physicochemical properties
   b. Identification data

3. Vehicle (if appropriate): Justification for choice, if other than water

4. Test animal
   a. Species/strain used
   b. Number, age and sex of animals
   c. Source, housing conditions, diet, etc.
   d. Individual weights of animals at the start of the test

5. Test conditions
   a. Doses
   b. Details of test substance formulation
   c. Details of administration of the test substance
   d. Details of food and water quality

6. Results
   a. Body weight/body-weight changes
   b. Food consumption
   c. Toxic response data by sex and dose level, including signs of toxicity
   d. Nature, severity and duration of clinical observations (whether reversible or not)
   e. Neurological assessment (as appropriate for the species tested) – e.g. sensory activity, grip strength and motor activity assessments in the rodent
   f. Haematological tests with relevant baseline values
   g. Clinical biochemistry tests with relevant baseline values
   h. Body weight at 24 hours (all animals), 7 days (both satellite groups) and at 14 days (for the remaining satellite group) or at time of unplanned death.
   i. Necropsy findings
   j. A detailed description of all histopathological findings
   k. Statistical treatment of results, where appropriate
   l. Analyses to confirm concentration of test substance in dosing solution

7. Discussion of results

8. Conclusions

H. References – The following references should be consulted for additional background material on this test guideline

1. OECD (Paris, 1992). Chairman's report of the meeting of the *ad hoc* working group of experts on systemic short-term and (delayed) neurotoxicity.

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ANNEX 6

Reports and other documents resulting from previous Joint Meetings of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and WHO Expert Groups on Pesticide Residues

1. Principles governing consumer safety in relation to pesticide residues. Report of a meeting of a WHO Expert Committee on Pesticide Residues held jointly with the FAO Panel of Experts on the Use of Pesticides in Agriculture. FAO Plant Production and Protection Division Report, No. PL/1961/11; WHO Technical Report Series, No. 240, 1962.
2. Evaluation of the toxicity of pesticide residues in food. Report of a Joint Meeting of the FAO Committee on Pesticides in Agriculture and the WHO Expert Committee on Pesticide Residues. FAO Meeting Report, No. PL/1963/13; WHO/Food Add./23, 1964.
3. Evaluation of the toxicity of pesticide residues in food. Report of the Second Joint Meeting of the FAO Committee on Pesticides in Agriculture and the WHO Expert Committee on Pesticide Residues. FAO Meeting Report, No. PL/1965/10; WHO/Food Add./26.65, 1965.
4. Evaluation of the toxicity of pesticide residues in food. FAO Meeting Report, No. PL/1965/10/1; WHO/Food Add./27.65, 1965.
5. Evaluation of the hazards to consumers resulting from the use of fumigants in the protection of food. FAO Meeting Report, No. PL/1965/10/2; WHO/Food Add./28.65, 1965.
6. Pesticide residues in food. Joint report of the FAO Working Party on Pesticide Residues and the WHO Expert Committee on Pesticide Residues. FAO Agricultural Studies, No. 73; WHO Technical Report Series, No. 370, 1967.
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18. Pesticide residues in food. Report of the 1972 Joint Meeting of the FAO Working Party of Experts on Pesticide Residues and the WHO Expert Committee on Pesticide Residues. FAO Agricultural Studies, No. 90; WHO Technical Report Series, No. 525, 1973.
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ANNEX 7

CORRECTIONS TO THE REPORT OF THE 1999 JMPR

Changes are shown in bold. Minor typographical errors are not included.

p. iii, Item 4.3

Correct spelling to **Buprofezin**

p. xi

Add the following:

Dr Jens-J. Larsen
Head, Department of General Toxicology
Institute of Toxicology
Danish Veterinary and Food Administration
Morkhoj Bygade 19
DK-2860 Soborg
Denmark
Tel: (45 33) 95 60 00
Fax: (45 33) 95 60 01
E-mail: jjl@vfd.dk

p. 24, para 2, last line

Change "Such a compound is identified in the Table below" to "**The compounds affected are** identified in the Table below".

p. 28 (Bitertanol), para 1, line 4

Change "…1983 when MRLs…" to "… **1984** when **TMRLs**…"

p. 34 (Bitertanol), para 3, line 2

Change "0.17 mg/kg for peaches and nectarines…" to "…**0.20** mg/kg for **peach** and **nectarine** …"

p. 39 (Bitertanol), para 5, line 1

Change "International Estimated Dietary Intakes" to "International Estimated **Daily** Intakes"

p. 40 (Buprofezin), para 6, line 2

Change "the 'thiobiuret' metabolite BF-25" to "the 'thiobiuret' **hydrolysis product BF-25**"

p. 40 (Buprofezin), para 6, line 4

"BF 27, both of which were identified in rats" to "BF-27 **which was** identified in rats"

p. 59 (Clethodim), para 1, line 2

Change "...2.9 and 7 ppm in the diet respectively, or 43.4" to "…**3.1** and 7 ppm in the diet, respectively, or **46.3**"

p. 66 (Dimethipin), paragraph 2, line 8

Change 800 to **80**

p. 66 (Dimethipin), paragraph 2, lines 8 and 9

In two places, **change** equal to **equivalent**

p. 80 (Ethoprophos), para 5, lines 3 and 4

Change "…3.1-78 µg/h (average, 34 µg/h) and the rate of exposure of the hands was calculated to be 0.2–18 µg/h (average, 6.3 µg/h)…" to "…3.1-78 **µg/h** (average, 34 **µg/h**), and the rate of exposure of the hands was calculated to be 0.2-18 **µg/h** (average, 6.3 **µg/h**)…"

p. 92 (Fenamiphos), para 2, line 1

Change "Degradation half-lives of 15.7 and 30 days" to "Degradation half-lives of ≤ 30 days"

p. 95 (Fenamiphos), para 6, line 5

Change "…trials which complied with GAP. The residues in rank order were …" to "…**US** trials which complied with GAP. The residues in **all the trials according to GAP in** rank order were ... "

p. 97 (Fenamiphos), para 6, line 1

Change "Eight trials…" to " **Seven** trials…"

p. 97 (Fenamiphos), para 6, line 2

"6 US trials…" to "**5** US trials…"

p. 97 (Fenamiphos), para 6, line 6

"...< 0.01–0.03 mg/kg..." to "< 0.01–**0.44** mg/kg…"

p. 97 (Fenamiphos), para 6, line 7

"…6 of the 8 trials..." to "…**5** of the **7** trials…"

p. 104 (Fenpropimorph), para 5, line 8

Change " -dimethylmorpholine-3-one…" to " **-dimethylmorpholin-3-one** …"

p. 105 (Fenpropimorph), last line

Add at end of paragraph after "…acid" "…acid**, expressed as fenpropimorph**"

p. 127 (Glufosinate-ammonium), para 1, lines 6 and 7

Change "sum of glufosinate-ammonium, and *N*-acetyl-glufosinate calculated as glufosinate (free acid)" to "**sum** of glufosinate-ammonium, **3-[hydroxy(methyl)phosphinoyl]propionic acid** and *N*-acetyl-glufosinate**, expressed** as glufosinate (free acid)"

p. 128 (Glufosinate-ammonium),para 2, line 2

Change "…4.4 ppm…" to "…**4.8** ppm…"

p. 128 (Glufosinate-ammonium),para 4, line 1

Change "...4.4 ppm…" to "…**4.8** ppm…"

p. 128 (Glufosinate-ammonium),para 5, line 2

Change "....STMR for maize forage…" to "…**STMRs** for maize forage **and almond hulls** …"

p. 139 (Malathion), para 5, lines 1 and 2

Change "…20 mg/kg and an STMR of 0.45 mg/kg…" to "…**10** mg/kg and an STMR of **0.20** mg/kg…"

p. 142 (Malathion), para 5, line 2

Change "…factors (PF) of 70…" to "…factors (PF) of **170**…"

p. 151 (Methiocarb), para 9, line 4

Change "The three relevant residues were all 0.05 mg/kg" to "The three relevant residues were all < 0.05 mg/kg"

p. 158, paragraph 6, line 5

Change 110 to **170**

p. 170 (2-Phenylphenol), para 1, line 2

Change "…84%…" to "…**87**%…"

p. 174 (Phosalone), para 2, line 1

Change "The current definition of phosalone is 'phosalone'" to "The current definition of **the residue** is 'phosalone'"

p. 174 (Phosalone), para 2, line 2

Delete "and oxo-phosalone"

p. 213, item 84

Change "Pesticide residues in food – 1997" to "Pesticides residues in food – **1998**"

p. 213, item 85

Delete "and Environmental"

p. 217 (Annex I), last full line

Change "…working documents of the Codex documents." to "…working documents of the Codex **Alimentarius Commission**."

pp. .218–227 (Annex 1), Table

The relevant sections are corrected below, with the errors crossed through and the corrections shown in bold. (A number of commodities were not listed in alphabetical order. This has been corrected in Annex I to the 1999 Evaluations but is not shown here).

Pesticide	ADI (mg/kg)	Commodity (Codex reference no.)		(mg/kg bw)	Recommended MRL (mg/kg)		STMR,
		CCN	Name		New	Previous	
Bitertanol ** (144)		Residue for compliance with MRLs for plant and animal commodities: bitertanol For estimation of dietary intake for plant commodities: bitertanol For estimation of dietary intake for animal commodities: sum of bitertanol, *p*-hydroxybitertanol and acid-hydrolysable conjugates of ~~*p*-hydrroxybiternol~~ ***p*-hydroxybiternol**					
Buprofezin (173)		**JF 0004**	Orange juice				0.012
Carbofuran (096)	0.002	~~FC 206~~ FC **0**206	Mandarin		0.5		0.1
Carbosulfan (145)	0.01	~~FC 206~~ FC **0**206	Mandarin		0.1		0.01
Dinocap (087)		Residue (for MRLs and STMRs): ~~dinocap~~ **sum of dinocap isomers and dinocap phenols, expressed as dinocap**					
Ethephon (106)			~~Pineapples~~, canned **Pineapple**, canned				0.036
		JF 0341	Pineapple juice				0.051
Ethoxyquin ** (035)		Residue for compliance with ~~MRLs and STMRs~~ **MRLs**: ethoxyquin. The residue for the estimation of dietary intake cannot be defined until the toxicities of the metabolites are known					
plant							
Fenamiphos ** (085)		SO 0691	Cottonseed		0.05*	0.05*	~~0~~ **0.01**
Malathion ** (049)		AL 1021	Alfalfa forage (green)		500 **(Dry wt.)**		157 **(Dry wt.)**
		AL 1023	Clover		500 **(Dry wt.)**		168 **(Dry wt.)**
		AF 0162	Grass forage		200	–	49.5
		AS 0162	~~Grass hay~~ **Hay or fodder (dry) of grasses**		300	–	44
		AF 0645	Maize forage		10 **(Dry wt.)**		0.20 **(Dry wt.)**
		VA 0389	~~Onion, Spring~~ **Spring onion**		5		0.52
		~~VJ 0448~~ **JF** 0448	Tomato juice		0.01		~~0.00~~
		Wheat forage			20 **(Dry wt.)**		4.14 **(Dry wt.)**
Tebufenozide (196)	**0.02** **0.021**	**JF 0226**			**Apple juice**		

Corrections to ANNEX IV of 1999 JMPR Report

CARBOFURAN (96) INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability factor	Case	IESTI, mg/kg bw/day	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion, g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FC 0206	Mandarin	0.5	0.0073		0.036	7.77	Jpn	52.6	409	100	Fra	72	72	7	Case 2a	0.0004	-
FC 0004	Oranges, sweet, sour	0.5	0.0073		0.036	8.68	USA	65	564	190	Fra	72	137	7	Case 2a	0.0006	-

CARBOFURAN (96) CHILDREN UP TO 6 YEARS

Commodity		Residue				Consumption				Unit weight				Variability factor	Case	IESTI, mg/kg bw/day	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion, g/kg bw	County	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FC 0206	Mandarin	0.5	0.0073		0.036	22.22	Jpn	15.9	353	100	Fra	72	72	7	Case 2a	0.0013	-
FC 0004	Oranges, sweet, sour	0.5	0.0073		0.036	34.14	UK	14.5	495	190	Fra	72	137	7	Case 2a	0.0026	-

CARBOSULFAN (145) INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability factor	Case	IESTI, mg/kg bw/day	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	ProcessFactor	HR mg/kg	Large portion, g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FC 0206	Mandarin	0.1	0.0007		0.0058	7.77	Jpn	52.6	409	100	Fra	72	72	7	Case 2a	0.00006	-
FC 0004	Oranges, sweet, sour	0.1	0.0007		0.0058	8.68	USA	65	564	190	Fra	72	137	7	Case 2a	0.00009	-

CARBOSULFAN (145)

CHILDREN UP TO 6 YEARS

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability factor	Case	IESTI, mg/kg bw/day	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FP 0206	Mandarin	0.1	0.0007		0.0058	22.22	Jpn	15.9	353	100	Fra	72	72	7	Case 2a	0.0002	-
FC 0004	Oranges, sweet, sour	0.1	0.0007		0.0058	34.14	UK	14.5	495	190	Fra	72	137	7	Case 2a	0.0004	-

DIAZINON (022)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption					Unit weight						
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion	Variability factor	Case	IESTI, mg/kg bw/day	% Acute RfD
FP 0009	Pome fruit	0.3	0.04		0.24												
FP 0226	Apple	0.3	0.04		0.24	20.74	USA	65	1348	138	USA	92	127	7	Case 2a	0.004	-
JF 0226	Apple juice		0.0004	0.01											Case 3		
	Apple sauce		0.0004	0.01											Case 3		
	Apple slices, canned		0.0004	0.01											Case 3		
FP 0230	Pear	0.3	0.04		0.24	10.66	USA	65	693	166	USA	91	151	7	Case 2a	0.004	-
VB 0041	Cabbages, Head	0.5	0.01		0.35	5	Fra	62.3	312	908	USA	79	717	5	Case 2b	0.009	-
MM 0814	Goat meat	2(fat) V	0.02			7.34	USA	65	477						Case 3		
MO 0098	Kidney of cattle, etc.	0.03 V	0.01			12.12	USA	65	788						Case 3		
MO 0099	Liver of cattle, etc.	0.03 V	0.01			5.84	USA	65	380						Case 3		
MM 0097	Meat of cattle, etc.	2(fat) V	0.02			7.5	Aus	70	525						Case 3		
ML 0106	Milks	0.02F V	0.02			37.94	USA	65	2466						Case 3		
VO 0448	Tomato	0.5	0.12		0.48	6.01	USA	65	391	123	USA	100	123	7	Case 2a	0.007	-

DIAZINON (022)

CHILDREN UP TO 6 YEARS

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability factor	Case	IESTI, mg/kg bw/day	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FP 0226	Apple	0.3	0.04		0.24	45.25	USA	15	679	138	USA	92	127	7	Case 2a	0.016	-
JF 0226	Apple juice		0.0004	0.01											Case 3		
	Apple sauce		0.0004	0.01											Case 3		
	Apple slices, canned		0.0004	0.01											Case 3		
VB 0041	Cabbages, Head	0.5	0.01		0.35	8.92	Jpn	15.9	142	908	USA	79	717	5	Case 2b	0.016	-
MM 0814	Goat meat	2(fat) V	0.02			5.08	USA	15	76						Case 3		
MO 0098	Kidney of cattle, etc.	0.03 V	0.01			12.44	USA	15	187						Case 3		
MO 0099	Liver of cattle, etc.	0.03 V	0.01			11.39	Fra	17.8	203						Case 3		
MM 0097	Meat of cattle, etc.	2(fat) V	0.02			13.72	Aus	19	261						Case 3		
ML 0106	Milks	0.02F V	0.02			85.71	USA	15	1286						Case 3		
FP 0230	Pear	0.3	0.04		0.24	19.24	USA	15	289	166	USA	91	151	7	Case 2a	0.017	-
FP 0009	Pome fruit	0.3	0.04		0.24												
VO 0448	Tomato	0.5	0.12		0.48	10.60	USA	15	159	123	USA	100	123	7	Case 2a	0.028	-

DINOCAP (87) INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD = 0.008 mg/kg bw

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw/day	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
VO 0448	Tomato	0.3	0.045		0.18	6.01	USA	65	391	105	Fra	97	102	7	Case 2a	0.002	30

DINOCAP (87)

CHILDREN UP TO 6 YEARS

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw/day	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
VO 0448	Tomato	0.3	0.045		0.18	10.6	USA	15	159	105	Fra	97	102	7	Case 2a	0.009	-

ETHEPHON (106) INTERNATIONAL ESTIMATED SHORT-TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw/day	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
VC 4199	Cantaloupe	1	0.24		0.63	9.32	USA	65	606	552	USA	50	276	5	Case 2a	0.015	-
DF 0269	Dried grapes (Currants, Raisins & Sultanas	5	0.84	2.7	2.2	2.17	Fra	62.3	135						Case 1	0.005	-
FB 0269	Grapes	1	0.31		0.82	7.33	Aus	70	513	125	Fra	94	118	7	Case 2a	0.011	-
VO0051	Peppers	5	0.98		2.4	3.33	Fra	62.3	207	119	USA	82	98	7	Case 2a	0.028	-
FI 0353	Pineapple	2	0.13		0.97	7.06	Jpn	52.6	371	472	USA	52	245	5	Case 2a	0.023	-
	Pineapple juice		0.051	0.39											Case 3		
	Pineapples, canned		0.036	0.28	0.27										Case 1		

VO 0448	Tomato	2	0.41		1.7	6.01	USA	65	391	123	USA	100	123	7	Case 2a	0.024	-
	Tomato juice		0.14	0.34											Case 3		
	Tomato paste		0.31	0.75											Case 3		
	Wine		0.31	1		16.88	Aus	70	1182						Case 3	0.005	-

ETHEPHON (106) CHILDREN UP TO 6 YEARS

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw/day	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
VC 4199	Cantaloupe	1	0.24		0.63	17.98	USA	15	270	552	USA	50	276	5	Case 2b	0.057	-
DF 0269	Dried grapes Currants, Raisins & Sultanas	5	0.84	2.7	2.2	3.95	USA	15	59				0		Case 1	0.009	-
FB 0269	Grapes	1	0.31		0.82	18	Aus	19	342	125	Fra	94	118	7	Case 2a	0.039	-
VO0051	Peppers	5	0.98		2.4	3.16	Aus	19	60	119	USA	82	98	7	Case 2b	0.053	-
FI 0353	Pineapple	2	0.13		0.97	13.61	Jpn	15.9	216	472	USA	52	245	5	Case 2b	0.066	-
	Pineapple juice		0.051	0.39											Case 3		
	Pineapples, canned		0.036	0.28	0.27										Case 1		
VO 0448	Tomato	2	0.41		1.7	10.6	USA	15	159	123	USA	100	123	7	Case 2a	0.099	-
	Tomato juice		0.14	0.34											Case 3		
	Tomato paste		0.31	0.75											Case 3		
	Wine		0.31	1		0.21	Aus	19	4						Case 3	0.000	-

FENAMIPHOS (85) INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD = 0.0008 mg/kg bw

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw/day	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FP 0226	Apple	0.05*	0.01		0.01	20.74	USA	65	1348	138	USA	92	127	7	Case 2a	0.0003	40
JF 0226	Apple juice		0.0078	0.78											Case 3		
FI 0327	Banana	0.05*	0.02		0.025	8.56	USA	65	556	900	Fra	68	612	5	Case 2b	0.00107	134
VB 0402	Brussels sprouts	0.05	0.01		0.01	6.25	NL	63	394						Case 1	0.0001	8
VB 0041	Cabbage, Head	0.05	0.01		0.05	8.98	NL	63	566	908	USA	79	717	5	Case 2b	0.0023	280
VR 0577	Carrot	0.2	0.02		0.08	5.32	NL	63	335	100	Fra	89	89	7	Case 2a	0.0009	110
SO 0691	Cotton seed	0.05*	0.01		0.01	0.05	USA	65	3.3						Case 1	0.0000	0
OR 0691	Cotton seed oil	0.05*	0.01			0.14	USA	65	9.1						Case 3	0.0000	0
MO 0105	Edible offal (Mam.)	0.01*	0			4.44	Fra	62.3	277								
PE 0112	eggs	0.01	0			3.51	Fra	62.3	219								
FB 0269	Grapes	0.1	0.02		0.09	7.33	Aus	70	513	125	Fra	94	118	7	Case 2a	0.0012	150
	Grape juice		0.009	0.45											Case 3		
	Raisins		0.0314	1.57	0.141	2.17	Fra	62.3	135						Case 1	0.0003	40
MM 0095	Meat (Mam-malian)	0.01*	0			7.52	Aus	70	526								
VC 0046	Melons exc. Water.	0.05*	0.02		0.02	10.08	USA	65	655	700	Fra	60	420	5	Case 2a	0.0007	90
ML 0106	Milks	0.01*	0			37.94	USA	65	2466								
SO 0697	Peanut	0.05*	0		0.01	2.59	Fra	62.3	161						Case 1	0.0000	3
OR 0697	Peanut oil, edible	0.05	0			0.91	Fra	62.3	57						Case 3	0.0000	0
VO 0051	Peppers	0.5	0.055		0.35	3.33	Fra	62.3	207	119	USA	82	98	7	Case 2a	0.0039	490
FI 0353	Pineapple	0.05*	0.01		0.14	7.06	Jpn	52.6	371	472	USA	52	245	5	Case 2a	0.0033	410

	Pineapple juice		0.012	1.2											Case 3		
PO 0111	Poultry, edible offal	0.01*	0			3.81	USA	65	248								
PM 0110	Poultry meat	0.01	0			6.21	Aus	70	435								
VO 0448	Tomato	0.5	0.05		0.3	6.01	USA	65	391	105	Fra	97	102	7	Case 2a	0.0035	440
JF 0448	Tomato juice		0.05	0.88											Case 3		
VC 0432	Watermelon	0.05	0.02		0.02	29.83	USA	65	1939	4518	USA	46	2078	5	Case 2b	0.0030	370

FENAMIPHOS (85)

CHILDREN UP TO 6 YEARS

Acute RfD = 0.0008 mg/kg bw

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw/day	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FP 0226	Apple	0.05*	0.01		0.01	45.25	USA	15	679	138	USA	92	127	7	Case 2a	0.0010	120
JF 0226	Apple juice		0.0078	0.78											Case 3		
FI 0327	Banana	0.05	0.02		0.025	19.61	Jpn	15.9	312	900	Fra	68	612	5	Case 2b	0.00245	306
VB 0402	Brussels sprouts	0.05	0.01		0.01	12.5	NL	17	213				0		Case 1	0.0001	20
VB 0041	Cabbage, head	0.05	0.01		0.05	13.06	NL	17	222	908	USA	79	717	5	Case 2b	0.0033	410
VR 0577	Carrot	0.2	0.02		0.08	11.5	Fra	17.8	205	100	Fra	89	89	7	Case 2a	0.0030	370
SO 0691	Cotton seed	0.05	0.01		0.01	0.05	USA	15	0.75						Case 1	0.0000	0
OR 0691	Cotton seed oil	0.05	0.01			0.41	USA	15	6.2						Case 3	0.0000	1
MO 0105	Edible offal	0.01	0			11.39	Fra	17.8	203								
PE 0112	eggs	0.01	0			7.5	Fra	17.8	134								
FB 0269	Grapes (excl. wine)	0.1	0.02		0.09	18	Aus	19	342	125	Fra	94	118	7	Case 2a	0.0041	520
	Grape juice		0.009	0.45											Case 3		
	Raisins		0.031	1.57	0.141	3.95	USA	15	59						Case 1	0.0006	70
MM 0095	Meat (Mammalian)	0.01*	0			13.71	Aus	19	260						Case 3	0.0000	0

VC 0046	Melons exc. Water.	0.05*	0.02		0.02	21.74	Aus	19	413	700	Fra	60	420	5	Case 2b	0.0022	270
ML 0106	Milks	0.01*	0			85.71	USA	15	1286								
SO 0697	Peanut	0.05*	0		0.01	5.18	USA	15	78						Case 1	0.0001	6
RO 0697	Peanut oil, edible	0.05	0			3.78	Fra	17.8	67						Case 3	0.0000	0
VO 0051	Peppers	0.5	0.055		0.35	3.16	Aus	19	60	119	USA	82	98	7	Case 2b	0.0077	970
FI 0353	Pineapple	5	0.01		0.14	13.61	Jpn	15.9	216	472	USA	52	245	5	Case 2b	0.0095	1200
	Pineapple juice		0.012	1.2											Case 3		
PO 0111	Poultry, edible offal	0.01*	0			2.47	USA	15	37								
PM 0110	Poultry meat	0.01*	0			11.78	Aus	19	224								
VO 0448	Tomato	0.5	0.05		0.3	10.6	USA	15	159	105	Fra	97	102	7	Case 2a	0.0145	1800
JF 0448	Tomato juice		0.05	0.88											Case 3		
VC 0432	Watermelon	0.05*	0.02		0.02	77.51	Aus	19	1473	4518	USA	46	2078	5	Case 2b	0.0078	970

FENPROPIMORPH (188) INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight							
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion	Variability	Case	IESTI, mg/kg bw	% Acute RfD
FI 0327	Banana	2	0.11		0.43	8.56	USA	65	556	708	USA	68	481	7	Case 2a	0.016	-
PE 0840	Chicken eggs	0.01*	0			3.51	Fra	62.3	219								
MO 0098	Kidney of cattle, goats, pigs and sheep	0.05	0.026			12.12	USA	65	788								
MO 0099	Liver of cattle, goats, pigs and sheep	0.3	0.22			5.84	USA	65	380								
MF 0100	Mammalian fats	0.01	0.006			1.16	Aus	70	81								
MM 0095	Meat (from mammals	0.02	0.009			7.52	Aus	70	526								

	other than marine mammals)																
ML 0106	Milks	0.01	0.004			37.94	USA	65	2466								
PF 0111	Poultry fats	0.01*	0			0.74	Fra	62.3	46								
PM 0111	Poultry meat	0.01*	0			6.21	Aus	70	435								
PO 0111	Poultry, edible offal	0.01*	0			3.81	USA	65	248								

FENPROPIMORPH 188) CHILDREN UP TO 6 YEAR

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FI 0327	Banana	2	0.11		0.43	19.61	Jpn	15.9	312	708	USA	68	481	5	Case 2b	0.042	-
PE 0112	Eggs [1]	0.01	0			7.5	Fra	17.8	134								
MO 0098	Kidney of cattle, goats, pigs and sheep	0.05	0.026			12.44	USA	15	187								
MO 0099	Liver of cattle, goats, pigs and sheep	0.3	0.22			11.39	Fra	17.8	203								
MF 0100	Mammalian fats	0.01	0.006			2.98	Aus	19	57								
MM 0095	Meat (from mammals other than marine mammals))	0.02	0.009			13.71	Aus	19	260								
ML 0106	Milks	0.01	0.004			85.71	USA	15	1286								
PF 0111	Poultry fats	0.01	0			1.11	Fra	17.8	20								
PM 0111	Poultry meat	0.01	0			11.78	Aus	19	224								
PO 0111	Poultry, edible offal	0.01	0			2.47	USA	15	37								

[1]Uses for consumption PE 0840, chicken eggs

FENPYROXIMATE (193) INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FP 0226	Apple	0.3	0.09		0.18	20.74	USA	65	1348	138	USA	92	127	7	Case 2a	0.0042	-
JF 0226	Apple juice		0.04	0.42											Case 3		
	Apple puree		0.05	0.54											Case 3		
FC 0004	Oranges, sweet, sour	0.2	0.01		0.09	8.68	USA	65	564	190	Fra	72	137	7	Case 2a	0.0014	-
FB 0269	Grapes	1	0.07		0.57	7.33	Aus	70	513	125	Fra	94	118	7	Case 2a	0.0071	-
	Wine		0.005	0.07		16.88	Aus	70	1182						Case 3	0.0001	-
DH 1100	Hops	10	4.4		8.4	0.09	USA	65	5.9						Case 1	0.0008	-
	Beer		0.004	0.001											Case 3		
ML 0812	Cattle milk	0.005* fat	0.005			39.92	NL	63	2515								
MM 0812	Cattle meat	0.05 fat	0.01			6.87	Aus	70	481								
MO 1280	Cattle kidney	0.01*	0			12.12	USA	65	788								
MO 1281	Cattle liver	0.01*	0			7.16	USA	65	465								

FENPYROXIMATE (193)

CHILDREN UP TO 6 YEARS

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight							
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion	Variability	Case	IESTI, mg/kg bw	% Acute RfD
FP 0226	Apple	0.3	0.09		0.18	45.25	USA	15	679	138	USA	92	127	7	Case 2a	0.0140	-
JF 0226	Apple juice		0.04	0.42											Case 3		
	Apple puree		0.05	0.54											Case 3		
FC 0004	Oranges sweet, sour	0.2	0.01		0.09	34.14	UK	14.5	495	190	Fra	72	137	7	Case 2a	0.0062	-
FB 0269	Grapes	1	0.07		0.57	18	Aus	19	342	125	Fra	94	118	7	Case 2a	0.0255	-
	Wine		0.005	0.07		0.21	Aus	19	4						Case 3	0.0000	-
DH 1100	Hops	10	4.4		8.4	0.03	JPN	15.9	0.48						Case 1	0.0003	-
	Beer		0.004	0.001											Case 3		
ML 0812	Cattle milk	0.005*F	0.005			76.33	Aus	19	1450								
MM 0812	Cattle meat	0.05 fat	0.01			12.52	Aus	19	238								
MO 1280	Cattle kidney	0.01*	0			12.44	USA	15	187								
MO 1281	Cattle liver	0.01*	0			11.39	Fra	17.8	203								

FOLPET (41)

INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight							
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion	Variability	Case	IESTI, mg/kg bw	% Acute RfD
FP 0226	Apple	10	3.1		8	20.74	USA	65	1348	110	Fra	91	100	7	Case 2a	0.146	-
	Apple juice		0.11												Case 3		
VC 0424	Cucumber	1	0.36		0.7	4.97	NL	63	313	301	USA	95	286	5	Case 2a	0.016	-
FB 0269	Grapes	10	2.5		5.9	7.33	Aus	70	513	125	Fra	94	118	7	Case 2a	0.083	-
	Grape juice		0.0075												Case 3		
DF 0269	Dried grapes (Currants, Raisins & Sultanas)	40	8		18.9	2.17	Fra	62.3	135						Case 1	0.041	-

	Wine		0												Case 3		
VL 0482	Lettuce, Head	50	14		39	3.27	USA	65	213								
VC 0046	Melons exc. Water.	3	0.41		2.2	10.08	USA	65	655	1000	USA	63	630	5	Case 2a	0.107	-
VA 0385	Onion, bulb	1	0.07		0.41	4.91	Fra	62.3	306	140	Fra	90	126	7	Case 2a	0.006	-
VR 0589	Potato	0.1	0.01		0.08	10.9	NL	63	687	200	Fra	80	160	7	Case 2a	0.002	-
FB 0275	Strawberry	5	1.6		2.2	5.55	Fra	62.3	346						Case 1	0.012	-
VO 0448	Tomato	3	0.9		2.4	6.01	USA	65	391	123	USA	100	123	7	Case 2a	0.035	-
	Tomato paste		0.025												Case 3		
	Tamato puree		0.025												Case 3		

FOLPET (41) CHILDREN UP TO 6 YEARS

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw/day	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FP 0226	Apple	10	3.1		8	45.25	USA	15	679	110	Fra	91	100	7	Case 2a	0.493	-
	Apple juice		0.11												Case 3		
VC 0424	Cucumber	1	0.36		0.7	9.53	NL	17	162	301	USA	95	286	5	Case 2b	0.033	-
FB 0269	Grapes	10	2.5		5.9	18	Aus	19	342	125	Fra	94	118	7	Case 2a	0.285	-
	Grape juice		0.0075												Case 3		
DF 0269	Dried grapes (Currants, Raisins & Sultanas)	40	8		18.9	3.95	USA	15	59						Case 1	0.075	-
	Wine		0												Case 3		
VL 0482	Lettuce, Head	50	14		39	4.92	NL	17	84								
VC 0046	Melons exc. Water.	3	0.41		2.2	21.74	Aus	19	413	1000	USA	63	630	5	Case 2b	0.239	-
VA 0385	Onion, bulb	1	0.07		0.41	7.14	Fra	17.8	127	140	Fra	90	126	7	Case 2a	0.020	-
VR 0589	Potato	0.1	0.01		0.08	19.23	UK	14.5	279	200	Fra	80	160	7	Case 2a	0.006	-
FB 0275	Strawberry	5	1.6		2.2	9.28	Aus	19	176						Case 1	0.020	-
VO 0448	Tomato	3	0.9		2.4	10.6	USA	15	159	123	USA	100	123	7	Case 2a	0.140	-
	Tomato paste		0.025												Case 3		
	Tamato puree		0.025												Case 3		

MALATHION (049) INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
VS 0621	Asparagus	1	0.305		0.69	6.32	NL	63	398	16	USA	56	9	7	Case 2a	0.0026	-
FB 0020	Blueberries	10	2.27		7.5	2.26	Aus	70	158						Case 1	0.017	-
VD 0071	Beans (dry)	2	0.215		1.2	4.1	Fra	62.3	255						Case 1	0.0049	-
VP 0061	Beans, except Broad bean and Soya bean	1	0.31		0.9	5	Fra	62.3	312						Case 1	0.0045	-
SO 0691	Cotton seed	20	4.8		14	0.05	USA	65	3.25						Case 1	0.0007	-
OR 0691	Cotton seed oil, edible	13	3.12	0.65		0.14	USA	65	9.1						Case 3	0.0004	-
VC 0424	Cucumber	0.2	0.02		0.1	4.97	NL	63	313	301	USA	95	286	7	Case 2a	0.0032	-
GC 0645	Maize	0.05	0.01		0.02	4.17	Fra	62.3	260						Case 1	0.0001	-
VL 0485	Mustard greens	2	0.07		1.1	3.5	USA	65	228						Case 1	0.0039	-
VA 0385	Onion, bulb	1	0.23		1	4.91	Fra	62.3	306	110	USA	91	100		Case 2a	0.012	-
VA 0389	Spring onion	5	0.52		5	0.86	Aus	70	60						Case 1	0.0043	-
VO 0051	Peppers	0.1	0.01		0.08	3.33	Fra	62.3	207	119	USA	82	98	7	Case 2a	0.0009	-
VL 0502	Spinach	3	0.35		2.2	13.01	NL	63	820	340	USA	72	245	7	Case 2a	0.063	-
FB 0275	Strawberry	1	0.25		0.59	5.55	Fra	62.3	346						Case 1	0.0033	-
VO 0447	Sweet corn	0.02	0.01		0.02	5.65	USA	65	367								
VO 0448	Tomato	0.5	0.21		0.41	6.01	USA	65	391	123	USA	100	123	7	Case 2a	0.0063	-
VJ 0448	Tomato juice	0.01	0.03	0.03											Case 3		
	Tomato puree		0.07	0.58											Case 3		
	Tomato catsup		0.09	0.75											Case 3		
VR 0506	Turnip, garden	0.2	0.05		0.13	3.61	USA	65	235	122	USA	86	105	7	Case 2a	0.0016	-
GC 0645	Wheat	0.5	0.702		1.9	5.89	USA	65	383						Case 1	0.0112	-

MALATHION (049) CHILDREN UP TO 6 YEARS

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
VS 0621	Aaparagus	1	0.305		0.69	11.88	USA	15	178	16	USA	56	9	7	Case 2a	0.0063	-
FB 0020	Blueberries	10	2.27		7.5	7.77	Fra	17.8	138						Case 1	0.0583	-
VD 0071	Beans (dry)	2	0.215		1.2	11.76	Fra	17.8	209						Case 1	0.0141	-
VP 0061	Beans, except Broad bean and Soya bean	1	0.31		0.9	11.39	Fra	17.8	203						Case 1	0.0103	-
SO 0691	Cotton seed	20	4.8		14	0.05	USA	15	0.8						Case 1	0.0007	-
OR 0691	Cotton seed oil, edible	13	3.12	0.65		0.41	USA	15	6.2						Case 3	0.0013	-
VC 0424	Cucumber	0.2	0.02		0.1	9.53	NL	17	162	301	USA	95	286	7	Case 2b	0.0067	-
GC 0645	Maize	0.05	0.01		0.02	8.33	Fra	17.8	148						Case 1	0.0002	-
VL 0485	Mustard greens	2	0.07		1.1	3.52	USA	15	53						Case 1	0.0039	-
VA 0385	Onion, bulb	1	0.23		1	7.14	Fra	17.8	127	110	USA	91	100	7	Case 2a	0.0400	-
VA 0389	Spring onion	5	0.52		5	1.52	Aus	19	29						Case 1	0.0076	-
VO 0051	Peppers	0.1	0.01		0.08	3.16	Aus	19	60	119	USA	82	98	7	Case 2b	0.0018	-
VL 0502	Spinach	3	0.35		2.2	22.2	NL	17	373	340	USA	72	245	7	Case 2a	0.2245	-
FB 0275	Strawberry	1	0.25		0.59	9.28	Aus	19	176						Case 1	0.0055	-
VO 0447	Sweet corn	0.02	0.01		0.02	11.09	UK	14.5	161								
VO 0448	Tomato	0.5	0.21		0.41	10.6	USA	15	159	123	USA	100	123	7	Case 2a	0.0240	-
VJ 0448	Tomato juice	0.01	0.03	0.03											Case 3		
	Tomato puree		0.07	0.58											Case 3		
	Tomato catsup		0.09	0.75											Case 3		
VR 0506	Turnip, garden	0.2	0.05		0.13	4.87	Jpn	15.9	77	122	USA	86	105	7	Case 2b	0.0044	-
GC 0645	Wheat	0.5	0.702		1.9	10.07	USA	15	151						Case 1	0.0191	-

METHIOCARB (132) INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD = 0.02 mg/kg bw

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw/	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FB 0275	Strawberry	1	0.44		0.83	5.55	Fra	62.3	346						Case 1	0.0046	20

CHILDREN UP TO 6 YEARS

Acute RfD = 0.02 mg/kg bw

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FB 0275	Strawberry	1	0.44		0.83	9.28	Aus	19	176						Case 1	0.0077	40

PHOSALONE (060) INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FP 0009	Pome fruit	2	0.8		1.5												
FP 0226	Apples	2	0.8		1.5	20.74	USA	65	1348	138	USA	92	127	7	Case 2a	0.0355	-
	Apple compote		0.1	0.14											Case 3		
FP 0230	Pears	2	0.8		1.5	10.66	USA	65	693	166	USA	91	151	7	Case 2a	0.0311	-
FS 0012	Stone fruits	2	0.45		1.6												
FS 0013	Cherries	2	0.45		1.6	6.02	Fra	62.3	375						Case 1	0.0096	-
FS 0240	Apricot	2	0.45		1.6	5.55	Jpn	52.6	292	40	Fra	93	37	7	Case 2a	0.0101	-

FS 0245	Nectarine	2	0.45		1.6	9.08	USA	65	590	136	USA	92	125	7	Case 2a	0.0248	-
FS 0247	Peaches	2	0.45		1.6	11.9	Jpn	52.6	626	110	Fra	90	99	7	Case 2a	0.0256	-
TN 0660	Almonds	0.1	0.05		0.074	1.4	Jpn	52.6	74						Case 1	0.0001	-
TN 0666	Hazelnuts	0.05	0.05		0.05	1	Aus	70	70						Case 1	0.0001	-
TN 0678	Walnuts	0.05	0.05		0.05	2.18	Fra	62.3	136						Case 1	0.0001	-

PHOSALONE (060) CHILDREN UP TO 6 YEARS

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight							
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion	Variability	Case	IESTI, mg/kg bw	% Acute RfD
FP 0009	Pome fruit	2	0.8		1.5												
FP 0226	Apples	2	0.8		1.5	45.25	USA	15	679	138	USA	92	127	7	Case 2a	0.1183	-
	Apple compote		0.1	0.14											Case 3		
FP 0230	Pears	2	0.8		1.5	19.24	UK	14.5	279	166	USA	91	151	7	Case 2a	0.1164	-
FS 0012	Stone fruits	2	0.45		1.6												
FS 0013	Cherries	2	0.45		1.6	16.67	Fra	17.8	297						Case 1	0.0267	-
FS 0240	Apricot	2	0.45		1.6	21.81	Aus	19	414	40	Fra	93	37	7	Case 2a	0.0309	-
FS 0245	Nectarine	2	0.45		1.6	15.89	Aus	19	302	136	USA	92	125	7	Case 2a	0.0779	-
FS 0247	Peaches	2	0.45		1.6	16.61	Aus	19	316	110	Fra	90	99	7	Case 2a	0.0635	-
TN 0660	Almonds	0.1	0.05		0.074	1.76	Fra	17.8	31						Case 1	0.0001	-
TN 0666	Hazelnuts	0.05	0.05		0.05	0.65	NL	17	11						Case 1	0.00003	-
TN 0678	Walnuts	0.05	0.05		0.05	0.37	USA	15	6						Case 1	0.00002	-

TEBUFENOZIDE INTERNATIONAL ESTIMATE OF SHORT TERM INTAKE (IESTI)
GENERAL POPULATION

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FP 0009	Pome fruits	1	0.17		1.1												
FP 0226	Apple	1	0.17		1.1	20.74	USA	65	1348	110	Fra	91	100	7	Case 2a	0.015	-
	Apple juice		0.021	0.125											Case 3		
	Apple puree		0.0425	0.25											Case 3		
FP 0230	Pear	1	0.17		1.1	10.66	USA	65	693	100	Fra	89	89	7	Case 2a	0.012	-
FB 0269	Grapes	1	0.25		0.5	7.33	Aus	70	513	125	Fra	94	118	7	Case 2a	0.007	-
	Wine		0.0625	0.25		16.88	Aus	70	1182						Case 3	0.001	-

TEBUFENOZIDE (196)

CHILDREN UP TO 6 YEARS

Acute RfD: May be necessary but has not yet been established

Commodity		Residue				Consumption				Unit weight				Variability	Case	IESTI, mg/kg bw	% Acute RfD
Code	Name	MRL mg/kg	STMR or STMR-P, mg/kg	Process Factor	HR mg/kg	Large portion g/kg bw	Country	Body weight, kg	Large portion g	Unit weight g	Country	% Edible portion	Unit weight, edible portion				
FP 0009	Pome fruits	1	0.17		1.1												
FP 0226	Apple	1	0.17		1.1	45.25	USA	15	679	110	Fra	91	100	7	Case 2a	0.058	-
	Apple juice		0.021	0.125											Case 3		
	Apple puree		0.0425	0.25											Case 3		
FP 0230	Pear	1	0.17		1.1	19.24	UK	14.5	279	100	Fra	89	89	7	Case 2a	0.049	-
FB 0269	Grapes	1	0.25		0.5	18	Aus	19	342	125	Fra	94	118	7	Case 2a	0.025	-
	Wine		0.0625	0.25		0.21	Aus	19	4						Case 3	0.000	-