

Joint FAO/WHO Food Standards Programme
CODEX ALIMENTARIUS COMMISSION

VOLUME 2

CODEX ALIMENTARIUS

PESTICIDE RESIDUES
IN FOOD

SECOND EDITION



FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS
WORLD HEALTH ORGANIZATION



Joint FAO/WHO Food Standards Programme
CODEX ALIMENTARIUS COMMISSION

CODEX ALIMENTARIUS
VOLUME TWO
PESTICIDE RESIDUES IN FOOD



FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS
WORLD HEALTH ORGANIZATION
Rome, 1993



The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

M-83
ISBN 92-5-103271-8

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying or otherwise, without the prior permission of the copyright owner. Applications for such permission, with a statement of the purpose and extent of the reproduction, should be addressed to the Director, Publications Division, Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, 00100 Rome, Italy.

© FAO and WHO, 1993

Printed in Italy

INTRODUCTION

The Maximum Residue Limits (MRLs) and other recommendations appearing in this Volume were adopted by the Codex Alimentarius Commission acting on the advice of its Committee on Pesticide Residues. They are consistent with the recommendations of the Joint FAO/WHO Meetings on Pesticide Residues (JMPR).

The JMPR is composed of two panels of experts¹ who serve in their personal capacity only and who do not represent or otherwise present the views of their governments or organizational affiliation. These experts meet jointly to evaluate selected pesticide residues on the basis of available data obtained from various sources, including governments, industry and academia. Where appropriate, they establish "Acceptable Daily Intakes" (ADIs) and recommend MRLs for residues of pesticides on foods and animal feeds.

Acceptance of Codex MRLs for pesticide residues by Member Nations and Associate Members of FAO and/or WHO, proceeds as described in Section 1, Volume 1 (1992), under "General Principles of the Codex Alimentarius".

¹ *The FAO Expert Panel on Pesticide Residues in Food and the Environment and the WHO Expert Panel on Pesticide Residues.*

CONTENTS

	Page
Introduction	iii
1. List of Codex Maximum Residue Limits (MRLs) for Pesticides	1
2. Codex Classification of Foods and Animal Feeds	147
3. Recommended Methods of Sampling for the Determination of Pesticide Residues . . .	367
4. Analysis of Pesticide Residues:	
4.1 Portion of Commodities to which Codex MRLs apply and which is Analyzed .	389
4.2 Guidelines on Good Laboratory Practice in Pesticide Residue Analysis	405
4.3 Recommended Methods of Analysis of Pesticide Residues	417
5. Definitions and References:	
5.1 Definitions for the Purpose of the Codex Alimentarius	459
5.2 References to Previous Codex Publications on Codex MRLs	465
5.3 References to FAO/WHO Publications Related to MRLs	469

SECTION 1

**LIST OF CODEX
MAXIMUM RESIDUE LIMITS
FOR PESTICIDES**

LIST OF CODEX MAXIMUM RESIDUE LIMITS FOR PESTICIDES

INTRODUCTION

The present volume contains all Maximum Residue Limits for pesticides adopted by the Commission up to and including its 19th Session. Further adoptions by the Commission will be published as an Addendum to Volume 2. The pesticides in this Section are listed in numerical order of the Codex code number. The missing numbers represent pesticides for which (a) Codex maximum limits are being elaborated, (b) for which previously established Codex MRLs have been withdrawn, or (c) for which only "guideline levels" have been recommended by the Joint Meeting on Pesticide Residues pending toxicological clearance of the pesticide and its residues.

BASIS FOR ESTABLISHMENT OF CODEX MAXIMUM RESIDUE LIMITS AND CODEX EXTRANEEOUS RESIDUE LIMITS

Codex "Maximum Residue Limits" (MRLs) are recommended on the basis of appropriate residue data obtained mainly from supervised trials. The residue data thus obtained reflect registered or approved usage of the pesticide in accordance with "good agricultural practices". These may vary considerably from region to region owing to differences in local pest control requirements which are due to a variety of reasons. Consequently, residues in food, particularly at a point close to harvest may also vary. In establishing Codex MRLs, these variations in residues due to differences in "good agricultural practices" are taken into consideration, as far as possible on the basis of available data.

As Codex MRLs cover a wide spectrum of use patterns and "good agricultural practices" and need to reflect residue levels closely following harvest, they may occasionally be higher than the levels of residues found in national surveillance activities. This may be especially so with easily degradable pesticides and when analysis is carried out at a point in the distribution chain far removed from the last application of the pesticide.

Codex MRLs are established only where there is supporting evidence concerning the safety to humans of the resulting residues as determined by the Joint FAO/WHO Meeting on Pesticide Residues and this means that Codex Maximum Residue Limits represent residue levels which are toxicologically acceptable.

Another type of Codex Maximum Limit, the Codex "Extraneous Residue Limit" (ERL) which covers residues arising from environmental contamination or uses of pesticides other than agricultural uses. It is mainly based on residue data obtained from national food control or monitoring activities. Codex ERLs need to cover widely varying residue levels in food reflecting differing situations in respect of contamination of food by environmental and persistent pesticide residues. For this reason, Codex ERLs cannot always reflect strictly the actual local residue situation existing in given countries or regions. Codex ERLs represent acceptable residue levels which are intended to facilitate international trade in food while protecting the health of the consumer. They are established only when there is supporting evidence concerning the safety to humans of the residues as determined by the Joint FAO/WHO Meeting on Pesticide Residues.

CODEX MAXIMUM RESIDUE LIMITS AND CONSUMER PROTECTION: DETERMINATION OF TOTAL DAILY INTAKE OF PESTICIDE RESIDUES

The primary purpose of setting maximum limits for pesticide residues in food and in some cases, in animal feeds, is to protect the health of the consumer. Codex MRLs and ERLs serve that primary purpose as they help to ensure that only the minimum amount of pesticide is applied to food consistent with real pest control needs. Codex Maximum Residue Limits are based on residue data from supervised trials and not directly derived from Acceptable Daily Intakes (ADIs), which are a quantitative expression of acceptable daily amounts of residue which persons may ingest on a long term basis and which are established on the basis of appropriate toxicological data mainly from animal studies.

The acceptability of Codex Maximum Residue Limits is judged on the basis of a comparison of the acceptable daily intake with estimated daily intakes, as determined on the basis of suitable intake studies. Intake data from such studies, compared with acceptable daily intakes, help in determining the safety of foods in respect of pesticide residues. Guidelines for predicting Dietary Intakes of Pesticide Residues have been prepared under the joint sponsorship of UNEP, FAO and WHO¹.

CODEX MAXIMUM RESIDUE LIMITS FOR MILK AND MILK PRODUCTS

Codex Maximum Residue Limits for fat-soluble pesticide residues in milk and milk products are expressed on a whole product basis.

For a "milk product" with a fat content less than 2%, the MRL applied should be half those specified for milk. The MRL for "milk products" with a fat content of 2% or more should be 25 times the maximum residue limit specified for milk, expressed on a fat basis.

Fat soluble pesticide residues to which the above general provision applies, are indicated by means of the letter "F" in conjunction with the MRL specified for milk.

CODEX MAXIMUM RESIDUE LIMITS FOR PROCESSED FOODS

As a rule, Codex MRLs and ERLs are established for raw agricultural commodities. However, where it is considered necessary for consumer protection and facilitation of trade, MRLs and ERLs are also established for certain processed foods on a case-by-case basis, taking into consideration information on the influence of processing on residues.

¹ (Ref. Guidelines for Predicting Dietary Intake of Pesticide Residues, Joint UNEP/FAO/WHO, World Health Organization, Geneva 1989).

EXPLANATORY NOTES

The foods listed in the columns marked "commodity" shall not contain more than the maximum amount (in mg/kg) stated in the columns marked "Maximum Residue Limit", of the pesticide residue (defined in each individual case in the definition of residue) at (a) the point of entry into a country or (b) at the point of entry into trade channels within a country. This maximum limit shall not be exceeded at any time thereafter.

The Codex maximum residue limits (MRLs) apply to the residue content of the final sample representative of the lot and of the portion of commodities which is analyzed. (See Section 4 of this Volume).

Dates of Estimation of Acceptable Daily Intakes (ADIs)

- ADIs - The year of estimation or confirmation is shown in parenthesis.
- TADIs - The period from the year of estimation or most recent extension to the year by which data needed for the estimation of a full ADI are required, is shown in parenthesis.

Notes on the MRLs

- (*) (following MRLs) : At or about the limit of determination.
- E (following MRLs) : Extraneous Residue Limit (ERL).
- F (following MRLs for milk) : The residue is fat soluble and MRLs for milk products are derived as explained earlier in this Section.
- (Fat) (following MRLs for meat) : The MRLs apply to the fat of meat.
- Po (following MRLs) : The MRL accommodates post-harvest treatment of the commodity.
- PoP (following MRLs for processed foods) : The MRL accommodates post-harvest treatment of the primary food commodity.
- T (following MRLs) : The MRL is temporary, irrespective of the status of the ADI, until required information has been provided and evaluated.
- V (following MRLs for products of animal origin) : The MRL accommodates veterinary uses.

ALPHABETIC INDEX OF PESTICIDE CHEMICALS FOR WHICH MAXIMUM RESIDUE LIMITS
HAVE BEEN RECOMMENDED OR ARE UNDER CONSIDERATION

95 ACEPHATE	118 CYPERMETHRIN	175 GLUFOSINATE-AMMONIUM	136 PROCYMIDONE
117 ALDICARB	169 CYROMAZINE	158 GLYPHOSATE	171 PROFENOFOS
1 ALDRIN AND DIELDRIN	20 2,4-D	114 GUAZATINE	148 PROPAMOCARB
134 AMINOCARB	104 DAMINOZIDE	43 HEPTACHLOR	113 PROPARGITE
122 AMITRAZ	21 DDT	44 HEXACHLOROBENZENE	160 PROPICONAZOLE
79 AMITROLE	135 DELTAMETHRIN	170 HEXACONAZOLE	75 PROPOXUR
163 ANILAZINE	92 DEMETON	176 HEXYTHIAZOX	150 PROPYLENETHIOUREA (PTU)
68 AZINPHOS-ETHYL	73 DEMETON-S-METHYL	45 HYDROGEN CYANIDE	153 PYRAZOPHOS
2 AZINPHOS-METHYL	164 DEMETON-S-METHYLSULPHONE	46 HYDROGEN PHOSPHIDE	63 PYRETHRINS
129 AZOCYCLOTIN	98 DIALIFOS	110 IMAZALIL	64 QUINTOZENE
155 BENALAXYL	22 DIAZINON	47 INORGANIC BROMIDE	89 SEC-BUTYLAMINE
137 BENDIOCARB	23 1,2-DIBROMOETHANE	111 IPRODIONE	121 2,4,5-T
69 BENOMYL	82 DICHLOFLUANID	131 ISOFENPHOS	115 TECNAZENE
172 BENTAZONE	24 1,2-DICHLOROETHANE	88 LEPTOPHOS	167 TERBUFOS
3 BINAPACRYL	25 DICHLORVOS	48 LINDANE	65 THIABENDAZOLE
93 BIORESMETHRIN	83 DICLORAN	49 MALATHION	154 THIODICARB
144 BITERTANOL	26 DICOFOL	102 MALEIC HYDRAZIDE	76 THIOMETON
4 BROMOPHOS	130 DIFLUBENZURON	50 MANCOZEB	77 THIOPHANATE-METHYL
5 BROMOPHOS-ETHYL	151 DIMETHIPIN	124 MECARBAM	162 TOLYLFLUANID
70 BROMOPROPYLATE	27 DIMETHOATE	138 METALAXYL	133 TRIADIMEFON
173 BUPROFEZIN	87 DINOCAP	125 METHACRIFOS	168 TRIADIMENOL
139 BUTOCARBOXIM	28 DIOXATHION	100 METHAMIDOPHOS	143 TRIAZOPHOS
174 CADUSAFOS	29 DIPHENYL	51 METHIDATHION	66 TRICHLORFON
71 CAMPHECHLOR	30 DIPHENYLAMINE	132 METHIOCARB	116 TRIFORINE
6 CAPTAFOL	31 DIQUAT	94 METHOMYL	78 VAMIDOTHION
7 CAPTAN	74 DISULFOTON	147 METHOPRENE	159 VINCLOZOLIN
8 CARBARYL	105 DITHIOCARBAMATES	52 METHYL BROMIDE	
72 CARBENDAZIM	84 DODINE	53 MEVINPHOS	
96 CARBOFURAN	99 EDIFENPHOS	54 MONOCROTOPHOS	
9 CARBON DISULPHIDE	32 ENDOSULFAN	140 NITROFEN	
10 CARBON TETRACHLORIDE	33 ENDRIN	55 OMETHOATE	
11 CARBOPHENOTHION	106 ETHEPHON	56 ORTHO-PHENYLPHENOL	
145 CARBOSULFAN	107 ETHIOFENCARB	126 OXAMYL	
97 CARTAP	34 ETHION	166 OXYDEMETON-METHYL	
80 CHINOMETHIONAT	149 ETHOPROPHOS	161 PACLOBUTRAZOL	
12 CHLORDANE	35 ETHOXYQUIN	57 PARAQUAT	
13 CHLORDIMEFORM	108 ETHYLENETHIOUREA (ETU)	58 PARATHION	
14 CHLORFENVINPHOS	123 ETRIMFOS	59 PARATHION-METHYL	
15 CHLORMEQUAT	85 FENAMIPHOS	120 PERMETHRIN	
16 CHLOROBENZILATE	109 FENBUTATIN OXIDE	127 PHENOTHRIN	
81 CHLOROTHALONIL	36 FENCHLORPHOS	128 PHENTHOATE	
17 CHLORPYRIFOS	37 FENITROTHION	112 PHORATE	
90 CHLORPYRIFOS-METHYL	38 FENSULFOTHION	60 PHOSALONE	
156 CLOFENTEZINE	39 FENTHION	103 PHOSMET	
18 COUMAPHOS	40 FENTIN	61 PHOSPHAMIDON	
19 CRUFOMATE	119 FENVALERATE	141 PHOXIM	
91 CYANOFENPHOS	152 FLUCYTHRINATE	62 PIPERONYL BUTOXIDE	
157 CYFLUTHRIN	165 FLUSILAZOLE	101 PIRIMICARB	
146 CYHALOTHRIN	41 FOLPET	86 PIRIMIPHOS-METHYL	
67 CYHEXATIN	42 FORMOTHION	142 PROCHLORAZ	

NUMERICAL INDEX OF PESTICIDE CHEMICALS FOR WHICH MAXIMUM RESIDUE LIMITS
HAVE BEEN RECOMMENDED OR ARE UNDER CONSIDERATION

1 ALDRIN AND DIELDRIN	51 METHIDATHION	101 PIRIMICARB	151 DIMETHIPIN
2 AZINPHOS-METHYL	52 METHYL BROMIDE	102 MALEIC HYDRAZIDE	152 FLUCYTHRINATE
3 BINAPACRYL	53 MEVINPHOS	103 PHOSMET	153 PYRAZOPHOS
4 BROMOPHOS	54 MONOCROTOPHOS	104 DAMINOZIDE	154 THIODICARB
5 BROMOPHOS-ETHYL	55 OMETHOATE	105 DITHIOCARBAMATES	155 BENALAXYL
6 CAPTAFOL	56 ORTHO-PHENYLPHENOL	106 ETHEPHON	156 CLOFENTEZINE
7 CAPTAN	57 PARAQUAT	107 ETHIOFENCARB	157 CYFLUTHRIN
8 CARBARYL	58 PARATHION	108 ETHYLENETHIOUREA (ETU)	158 GLYPHOSATE
9 CARBON DISULPHIDE	59 PARATHION-METHYL	109 FENBUTATIN OXIDE	159 VINCLOZOLIN
10 CARBON TETRACHLORIDE	60 PHOSALONE	110 IMAZALIL	160 PROPICONAZOLE
11 CARBOPHENOTHION	61 PHOSPHAMIDON	111 IPRODIONE	161 PACLOBUTRAZOL
12 CHLORDANE	62 PIPERONYL BUTOXIDE	112 PHORATE	162 TOLYLFLUANID
13 CHLORDIMEFORM	63 PYRETHRINS	113 PROPARGITE	163 ANILAZINE
14 CHLORFENVINPHOS	64 QUINTOZENE	114 GUAZATINE	164 DEMETON-S-METHYLSULPHONE
15 CHLORMEQUAT	65 THIABENDAZOLE	115 TECNAZENE	165 FLUSILAZOLE
16 CHLOROBENZILATE	66 TRICHLORFON	116 TRIFORINE	166 OXYDEMETON-METHYL
17 CHLORPYRIFOS	67 CYHEXATIN	117 ALDICARB	167 TERBUFOS
18 COUMAPHOS	68 AZINPHOS-ETHYL	118 CYPERMETHRIN	168 TRIADIMENOL
19 CRUFOMATE	69 BENOMYL	119 FENVALERATE	169 CYROMAZINE
20 2,4-D	70 BROMOPROPYLATE	120 PERMETHRIN	170 HEXACONAZOLE
21 DDT	71 CAMPHECHLOR	121 2,4,5-T	171 PROFENOFOS
22 DIAZINON	72 CARBENDAZIM	122 AMITRAZ	172 BENTAZONE
23 1,2-DIBROMOETHANE	73 DEMETON-S-METHYL	123 ETRIMFOS	173 BUPROFEZIN
24 1,2-DICHLOROETHANE	74 DISULFOTON	124 MECARBAM	174 CADUSAFOS
25 DICHLORVOS	75 PROPOXUR	125 METHACRIFOS	175 GLUFOSINATE-AMMONIUM
26 DICOVOL	76 THIOMETON	126 OXAMYL	176 HEXYTHIAZOX
27 DIMETHOATE	77 THIOPHANATE-METHYL	127 PHENOTHIRIN	
28 DIOXATHION	78 VAMIDOTHION	128 PHENTHOATE	
29 DIPHENYL	79 AMITROLE	129 AZOCYCLOTIN	
30 DIPHENYLAMINE	80 CHINOMETHIONAT	130 DIFLUBENZURON	
31 DIQUAT	81 CHLOROTHALONIL	131 ISOFEINPHOS	
32 ENDOSULFAN	82 DICHLORFLUANID	132 METHIOCARB	
33 ENDRIN	83 DICLORAN	133 TRIADIMEFON	
34 ETHION	84 DODINE	134 AMINOCARB	
35 ETHOXYQUIN	85 FENAMIPHOS	135 DELTAMETHRIN	
36 FENCHLORPHOS	86 PIRIMIPHOS-METHYL	136 PROCYMIDONE	
37 FENITROTHION	87 DINOCAP	137 BENDIOCARB	
38 FENSULFOTHION	88 LEPTOPHOS	138 METALAXYL	
39 FENTHION	89 SEC-BUTYLAMINE	139 BUTOCARBOXIM	
40 FENTIN	90 CHLORPYRIFOS-METHYL	140 NITROFEN	
41 FOLPET	91 CYANOFENPHOS	141 PHOXIM	
42 FORMOTHION	92 DEMETON	142 PROCHLORAZ	
43 HEPTACHLOR	93 BIORESMETHRIN	143 TRIAZOPHOS	
44 HEXACHLOROBENZENE	94 METHOMYL	144 BITERTANOL	
45 HYDROGEN CYANIDE	95 ACEPHATE	145 CARBOSULFAN	
46 HYDROGEN PHOSPHIDE	96 CARBOFURAN	146 CYHALOTHRIN	
47 INORGANIC BROMIDE	97 CARTAP	147 METHOPRENE	
48 LINDANE	98 DIALIFOS	148 PROPAMOCARB	
49 MALATHION	99 EDIFENPHOS	149 ETHOPROPHOS	
50 MANCOZEB	100 METHAMIDOPHOS	150 PROPYLENETHIOUREA (PTU)	

LIST OF CODEX MAXIMUM RESIDUE LIMITS FOR PESTICIDES

References

- (1) **Code Number and Name of Commodity** - Reference to the Codex Classification of Foods and Animal Feeds [see Section 2].
- (2) **JMPR** - Year of the JMPR evaluation or subsequent review.
- (3) **CCPR** - Number of CCPR session and paragraph of the related CCPR report (i.e. 23.105).

(1) ALDRIN AND DIELDRIN

JMPR 65, 66, 67, 68, 69, 70, 74, 75, 77, 90
ADI 0.0001 mg/kg body weight | (Confirmed 1977)
Residue Sum of HHDN and HEOD (fat-soluble).
Note 23rd CCPR (1991) agreed with the recommendation of the 1990 JMPR
to convert existing CXLs to TERLs, pending monitoring data (23.71).

Commodity		MRL (mg/kg)	
code No.	N a m e		
VS 0621	Asparagus	0.1	E T
VB 0400	Broccoli	0.1	E T
VB 0402	Brussels sprouts	0.1	E T
VB 0041	Cabbages, Head	0.1	E T
VR 0577	Carrot	0.1	E
VB 0404	Cauliflower	0.1	E T
GC 0080	Cereal grains	0.02	E
VC 0424	Cucumber	0.1	E T
VO 0440	Egg plant	0.1	E T
PE 0112	Eggs	0.1	E
A02 0001	Fruits	0.05	E T
VR 0583	Horseradish	0.1	E T
VL 0482	Lettuce, Head	0.1	E
MM 0095	Meat	0.2 (fat)	E
ML 0106	Milks	0.006 F	E
VA 0385	Onion, Bulb	0.1	E T
VR 0588	Parsnip	0.1	E T
VO 0051	Peppers	0.1	E T
VO 0445	Peppers, Sweet	0.1	E T
VR 0589	Potato	0.1	E T
VR 0494	Radish	0.1	E T
VL 0494	Radish leaves	0.1	E T

(2) AZINPHOS-METHYL

JMPR 65, 68, 72, 73, 74, 91
ADI 0.005 mg/kg body weight | (1991)
Residue Azinphos-methyl.

Commodity			MRL (mg/kg)	
code No.	N a m e			
AL 1021	Alfalfa forage (green)		2	
TN 0660	Almonds		0.2	
FS 0240	Apricot		2	1/
VB 0400	Broccoli		1	
VB 0402	Brussels sprouts		1	1/
VS 0624	Celery		2	1/
GC 0080	Cereal grains		0.2	
FC 0001	Citrus fruits		2	1/
SO 0691	Cotton seed		0.2	
A02 0002	Fruits (except..)		1	1/ 2/
FB 0269	Grapes		4	
FI 0341	Kiwifruit		4	
VC 0046	Melons, except Watermelon		2	
AL 0528	Pea vines (green)		2	1/
FS 0247	Peach		4	
VR 0589	Potato		0.2	
VD 0541	Soya bean (dry)		0.2	
AL 1265	Soya bean forage (green)		2	fresh wt
SO 0702	Sunflower seed		0.2	1/
A01 0002	Vegetables (except..)		0.5	1/ 2/

1/ JMPR 1991 recommended to withdraw the MRL
2/ (Except as otherwise listed)