Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development 29-Jul-2008

English - Or. English

ENVIRONMENT DIRECTORATE
JOINT MEETING OF THE CHEMICALS COMMITTEE AND THE WORKING PARTY ON CHEMICALS, PESTICIDES AND BIOTECHNOLOGY

ENV/JM/MONO(2008)23
Unclassified

SERIES ON TESTING AND ASSESSMENT
Number 96

GUIDANCE DOCUMENT ON MAGNITUDE OF PESTICIDE RESIDUES IN PROCESSED COMMODITIES

English - Or. English

JT03249288

OECD Environment, Health and Safety Publications

Series on Testing and Assessment

No. 96

GUIDANCE DOCUMENT ON MAGNITUDE OF PESTICIDE RESIDUES IN PROCESSED COMMODITIES

IOMC

INTER-ORGANIZATION PROGRAMME FOR THE SOUND MANAGEMENT OF CHEMICALS

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Paris 2008

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This publication was developed in the IOMC context. The contents do not necessarily reflect the views or stated policies of individual IOMC Participating Organizations.

The Inter-Organisation Programme for the Sound Management of Chemicals (IOMC) was established in 1995 following recommendations made by the 1992 UN Conference on Environment and Development to strengthen co-operation and increase international co-ordination in the field of chemical safety. The participating organisations are FAO, ILO, OECD, UNEP, UNIDO, UNITAR and WHO. The World Bank and UNDP are observers. The purpose of the IOMC is to promote co-ordination of the policies and activities pursued by the Participating Organisations, jointly or separately, to achieve the sound management of chemicals in relation to human health and the environment.

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FOREWORD

This guidance document was developed by an Expert Group on Pesticide Residue Chemistry (RCEG) led by the United States, and composed of experts from Australia, Canada, Germany, Italy, Japan, the Netherlands, New Zealand, the United Kingdom, the United States, the European Commission, FAO and BIAC. This expert group reported to the Working Group on Pesticides (WGP) which had oversight of the initial phase of development up to production of the final draft proposal, and to the Working Group of the National Coordinators of the Test Guidelines Programme (WNT).

In December 2007, the Secretariat circulated a draft Test Guideline to the WGP and the WNT for comments. Based on the comments received, the draft Test Guideline was revised at the RCEG meeting which took place on 22-24 January 2008; the RCEG meeting also decided to split the initial Test Guideline proposal into two documents: a Test Guideline and this guidance document. The WNT approved the draft guidance document and Test Guideline at its 20th meeting, in April 2008.

This guidance document is published on the responsibility of the Joint Meeting of the Chemicals Committee and Working Party on Chemicals, Pesticides and Biotechnology.

GUIDANCE DOCUMENT ON MAGNITUDE OF PESTICIDE RESIDUES IN PROCESSED COMMODITIES

Introduction

1. A wide range of raw agricultural commodities (RAC) are processed before consumption by the public. In fact, many RACs are consumed in multiple processed forms [e.g. grapes (RAC), raisins, grape juice, wine; potato (RAC), chips, cooked, baked and fried potato, dehydrated flakes]. The processes that are used (industrial or domestic) to produce these foods are diverse and varied.

2. From a consumer protection point of view it is always important to know not only the residues in the RACs but also the residues in the processed commodities, i.e. in the ready-to-eat food. This information is essential for refinement of the dietary exposure. Additionally, it is important to know the residues in processed feeds to calculate the dietary burden for feeding studies and thus to estimate the probable residues in products of animal origin.

3. Studies on the magnitude of residues in processed commodities provide data on the transfer of residues to different processed commodities from the raw agricultural commodity (RAC). Studies on the magnitude of residues are conducted in order to quantify levels of residues in processed commodities and to provide the distribution of residues (active ingredient, and/or metabolites, degradation products) in various processed products resulting from the processing of a commodity. This information about dilution and concentration of residues and the estimation of processing factors (the ratio of residue levels in processed commodities to those in the raw agricultural commodity) is used to:

- conduct refined dietary exposure assessments with primary processed products to assess consumer safety,
- provide results on residues in commodities that may be used as animal feedstuffs and thus to allow a more realistic calculation of the dietary burden of livestock,
- establish MRLs for processed commodities,
- monitor compliance with the RAC MRL.

Further information associated with the guideline on the conduct and interpretation of studies on magnitude of residues in processed commodities is provided here. It provides some flexibility necessary to address the needs of the appropriate regulatory authority as well as to deal with unpredictable results.

Applicability of processing studies

5. This guidance document applies to RACs of plant origin. It also applies to RACs of animal origin in cases of direct animal treatment or veterinary use. Applicability of studies on the magnitude of residues in processed commodities depends upon the importance of a processed product in the human and/or animal diet; the possibility of residue levels in processed foods/feeds exceeding the level in a RAC; the level of residue in the plant or plant product to be processed (RAC); the physical-chemical properties of the active ingredient or relevant metabolites; and the possibility that degradation products of toxicological significance may be found after processing of the plant or plant product. Annex 1 contains a range of possible

processed commodities and percent dry matter for default dehydration factors, Table 4 provides percent oil content to aid in decisions on extrapolation of oil seeds; and Table 5 provides categories of processing procedures and possible extrapolations.

Processing factor

6. The processing factor (P*f*), for residues of a compound in the processed commodity that originate only from residues of the same single compound in the RAC, is calculated as follows:

$$Pf = \frac{\text{residue level in processed commodity}}{\text{residue level in the RAC or commodity to be processed}}$$

For the calculation of the P*f,* three different cases have to be considered.

a) Residue definition for MRL setting and for dietary exposure assessment is identical:

Thiacloprid was considered by the 2006 JMPR. Based on the nature of residue in plant, the residue definition for both enforcement (residue monitoring) and dietary exposure assessment was defined as thiacloprid. Additionally, a nature of the residue study for processing showed that thiacloprid is stable to typical hydrolytic processing conditions. Two processing studies were reported for tomatoes, and some of the information is summarized in Table 1.

Table 1: Example calculation of a processing factor for residues of thiacloprid in tomato paste

Study Number	Commodity	Thiacloprid, mg/kg	P*f*
1	Tomato (RAC)	0.24	-
	Paste	0.48	2.0
2	Tomato (RAC)	0.07	-
	Paste	0.22	3.1

The mean processing factor for tomato paste, 2.6, may be used for both monitoring (enforcement) and dietary exposure assessment considerations.

b) Residue definitions for MRL setting and for dietary exposure assessment differ:

In this case it is necessary to calculate two values if the processing factor is used to establish MRLs for processed commodities, or to monitor compliance with GAP in combination with the RAC MRL, and to conduct dietary exposure assessments. In 2005, JMPR evaluated residues of cyhexatin. The residue definition for compliance with MRLs and estimation of dietary intake in plant and animal commodities was cyhexatin. Nevertheless, in the case of processing, results for the metabolite DCTO were also reported. It is assumed that the definition for dietary exposure assessment then is "sum of cyhexatin and DCTO, expressed as cyhexatin". The following Table 2 gives the results from apple processing as reported in the JMPR Evaluations 2005.

Table 2: Example for calculation of a processing factor for residues of cyhexatin (Cy) and the metabolite (DCTO) in wet and dry pomace

Apple, RAC			Wet Pomace					Dry Pomace				
Cy mg/kg	DCTO mg/kg	Sum[1]	Cy mg/kg	DCTO mg/kg	Sum[1]	P*f* for MRL[2]	P*f* for Dietary[3]	Cy mg/kg	DCTO mg/kg	Sum[1]	P*f* for MRL[4]	P*f* for Dietary[5]
0.09	0.02	0.11	0.15	0.04	0.20	1.7	1.8	0.13	0.01	0.14	1.4	1.3
0.03	0.01	0.04	0.1	0.02	0.12	3.3	3.0	0.12	0.02	0.14	4	3.5
0.05	0.01	0.06	0.11	0.03	0.15	2.2	2.5	0.01	<0.01	0.02	0.2	0.33
0.03	0.01	0.04	0.05	0.03	0.09	1.7	2.2					
0.04	0.01	0.05	0.05	0.03	0.09	1.2	1.8					
0.12	0.02	0.14	0.16	0.07	0.25	1.4	1.8					
0.03	0.01	0.04	0.05	0.02	0.07	1.7	1.8					
0.06	0.02	0.08	0.09	0.03	0.13	1.5	1.6					
Median Pf						1.7	1.8				1.4	1.3

1 Sum of Cy and DCTO, after molecular weight adjustment (DCTO X 1.28 or 385 / 301). Used for calculation of the P*f* for dietary intake consideration purposes.

2 [Cy wet pomace] / [Cy apple]

3 [Sum wet pomace] / [Sum apple]

4 [Cy dry pomace] / [Cy apple]

5 [Sum dry pomace] / [Sum apple]

The median processing factor for MRL monitoring of wet pomace is 1.7, whereas the factor for dietary exposure calculation considerations is 1.8. This calculation assumes that the ADI and/or ARfD are single values representing both cyhexatin and DCTO. A different dietary exposure calculation would be required if cyhexatin and DCTO had separate ADI and/or ARfDs.

c) Additional metabolites/degradates in processed commodities have to be taken into account:

This case is in principle covered by para 20 (vii) of the OECD Guidance Document on the Definition of Residue. It is stated that these metabolites/degradates may also have to be considered in the dietary exposure assessment.

7. Default and theoretical processing factors may be derived in some cases. In processes where dehydration is the path from RAC to processed commodity, a simple calculation based on the loss of water is sufficient for derivation of default generic processing factors to assess the potential for exceedance of a RAC MRL. Annex I provides some of these factors. While these factors may be used to perform a preliminary dietary exposure assessment, it is not considered good practice to establish MRLs for processed commodities based on default dehydration factors (% dry matter or %DM). Theoretical processing factors can also be derived for preparation of oil taking into account the oil content and assuming that all residues will accumulate in the oil. In addition, for some crops, theoretical processing factors have been published by US EPA. Table 3 gives some examples.

Table 3. Examples of theoretical processing factors

RAC	Processed commodity	Theoretical P*f*	Remarks
apple	Pomace	>14	
small cereal grains	Bran	8	
corn	Oil	25	
sugar beet	Sugar	12	
citrus	Oil	1000	
coffee	roasted beans	4.5	
grapes	raisins	5	
mint	oil	330	
tomato	pomace	5.5	
pineapple	bran/pomace	4	livestock feed
potato	culls	5	livestock feed
safflower	meal	9	livestock feed
sugarcane	bagasse	12	livestock feed
sunflower	meal	4.5	livestock feed

Processing procedure types and extrapolation

8. Commodities fall into natural types with respect to processing. These commodity types may or may not align with field trial crop groupings globally. Additional justification for types of extrapolation follows.

9. For commodities belonging to the same commodity type and undergoing the same processing procedure it is assumed that the results from studies from one commodity can be extrapolated to the other commodities of this type, including all similar processed commodities within the procedure. For example, results from processing oranges to orange juice or pomace can be extrapolated to other citrus fruits.

10. Oilseeds generally fall into two types: low (approximately 20%) and high (approximately 50%) oil content. Some examples of oil content of different oilseeds are given in Table 4. The oil content may be used to prevent underestimation of dietary intake when extrapolating from a high oil content oilseed to a low oil content oilseed. Also, the oil content affects the type of procedure used. "High oil content oilseeds (sometimes referred to as soft seeds) generally have over 30 percent oil content in the unprocessed feed stock. The relatively high oil content needs to be reduced prior to solvent application to allow the solvent to efficiently bond to the oil. Reducing the oil content of an oilseed is accomplished by flaking, heating and mechanically pre-pressing the material prior to solvent application. Prepressing reduces the oil content of the remaining material to less than 25 percent. "Oilseeds with an oil content of less than 30 percent do not require prepressing. The low oil content eliminates the need to reduce the oil content before solvent application. Soybeans, with an oil content of approximately 18 percent, are an example of low oil content oilseed. The preparation process for soybeans involves de-hulling, cracking, and rolling and flaking." (J. Schumacher. Large Scale Commercial Oilseed Processing Agricultural Marketing Policy Center, Montana State University Extension, Briefing No. 87, May 2007.)

Table 4: Examples of oilseeds and their oil content

Oilseed	Oil Content (wt %)	Reference
Soybean	20	Scott Taylor et al
	13 – 24	Container Handbook
	21 – 22	Canadian Grain Commission
Safflower	40	Scott Taylor et al
	25 – 35	Container Handbook
Sunflower	42	Scott Taylor et al
	19 – 56	Container Handbook
	44 – 48	C. Trostle
Rapeseed (Canola)	42	Scott Taylor et al
	38 – 42	Container Handbook
	43 – 44	Canadian Grain Commission
	43 – 44	P. Laaniste et al
Cottonseed	20	Scott Taylor et al
	18 – 26	Container Handbook
Niger seed	40 – 50	Container Handbook
Oiticica seed	60 – 63	Container Handbook
Olives, fresh	40 – 60	Container Handbook
Oil palm, flesh	65 – 72	Container Handbook
Perilla seed	44	Container Handbook
Flaxseed	46	Canadian Grain Commission
Meadowfoam	21 – 25	Harbans Bhardwaj
Cuphea	25 – 30	R. W. Gesch et al

11. Table 5 gives some examples for various processing procedures and possible extrapolations. From the previous example, the results of a processing study to prepare orange juice from oranges might be translated to other tropical fruit juices. In these cases, an extrapolation to other processed commodities occurring during the same procedure may or may not be extrapolated. The possibility of extrapolation should be carefully examined and discussed with the appropriate regulatory authorities. The complete list of Types may be found in the Annex.

Table 5: Processing Procedure Types and Recommended Extrapolations Using Typical RACs

Type	**Processing procedure**	**Explanations**	**Examples of typical crop/RAC[1)]**	**Extrapolations**	**Domestic or Industrial[2)]**
Category 1 (Major Industrial Procedures)[3)]					
II	Preparation of fruit juice	Also covering pomace or dried pulp (byproducts) as an animal feed	orange apples grapes (see #V also)	orange → citrus (juice, feed), tropical fruits (juice only) apple→pome fruit, stone fruit (juice, feed) grapes→small berries (juice, feed)	D/I
V	Preparation of alcoholic beverages	Fermentation Malting Brewing Distillation	Grapes (wine) Rice Barley Hops Other Cereals	Grapes[4)]→ all wine-producing RACs except rice Rice (beer, wine)→None	D/I

Type	Processing procedure	Explanations	Examples of typical crop/RAC[1)]	Extrapolations	Domestic or Industrial[2)]
			(wheat, maize, rye) Sugar cane	Barley[5)]→all beer-producing RACs (except rice and hops) Barley→all whiskey-type producing RACs	
VII	Preparation of vegetable juice	Includes preparation of concentrated juices, e.g., tomato puree and paste	Tomatoes Carrot	Tomato→all vegetables	D/I
X	Preparation of oil	Pressing or extraction including meal or press cake used as animal feed	Rapeseed (canola) Olives Maize (Corn)	1)Solvent extraction (crushing): Olive→None cottonseed↔soybean→ rapeseed (canola)↔ other oil seeds 2)Cold press: Olive→None cottonseed↔soybean→ rapeseed (canola)↔ other oil seeds 3)Milling (wet&dry): Maize→None	I
XI	Distribution on milling	Including bran and gluten used as animal feed. Other grain fractions used as feeds.	Wheat Rice Maize (corn)	Wheat→all small grains except rice (oats, barley, triticale, rye) Rice→wild rice Maize (corn, dry milling)→ sorghum	I
XIV	Silage production	Important animal feed items.	Beets Pasture grass, alfalfa	Beets (pulp) → roots and tubers Pasture grass / alfalfa silage → all green plant silage	I
XII	Preparation of sugar	Molasses and bagasse (used as animal feed) are only items that might contain concentrated residues. Other processed commodities, such as sugar, should also be evaluated.	sugar beets, sugar cane sweet sorghum	Cane↔beet (only refined sugar)	I
Category 2 (Other Industrial Procedures and Domestic or Home Procedures[6)]					
XIII	Infusions and extractions	Infusions, including green and black tea. Roasting and extraction (including instant coffee)	Tea Cacao Coffee	None	D/I
III	Preparation of canned fruit		Apple/Pear Cherry/peach Pineapple	Any fruit canned with skin → all canned fruits	D/I

Type	Processing procedure	Explanations	Examples of typical crop/RAC[1)]	Extrapolations	Domestic or Industrial[2)]
IV	Preparation of other fruit products (primary procedures only)	Includes production of marmalade, jam, jelly, sauce/puree[7)]	Pome fruit Stone fruit Grape Citrus (orange)	Any one fruit→other major fruits	D/I
VI	Cooking vegetables, pulses and grains in water (including steaming)		Carrots Beans/peas, (dry) Beans/peas (succulent) Potatoes Spinach Rice [polished (white) or husked (brown)]	Spinach → leafy vegetables, brassica vegetables (<20 minutes) Potatoes → root, tuber, bulb vegetables, fresh legumes (>20 minutes) Rice →all grains	D
VIII	Preparation of canned vegetables		Common (green or snap) bean Corn (sweet) Pea (garden, succulent) Potato Spinach Beet (garden, table) Tomato Pulses (pea or bean)	Common bean, corn, pea, or spinach→all vegetables Potato → sweet potato	D/I
IX, XVIII	Miscellaneous preparations of other vegetable products	Frying Microwaving Baking	Potatoes	Potatoes→all vegetables (microwaving) Potatoes→all vegetables (frying and baking)	D/I
XV	Processing of products of animal origin including preparation of meat and fish[8)]	Churning Boiling/poaching Baking/smoking Frying Fermentation	Milk Eggs Meat Fish	None	D/I
XVI	Dehydration[9)]	Removal of water	Fruits (esp grapes, plums) Vegetables Potatoes Grasses	None	I
XVII	Fermentation of soybeans, rice and others (except alcoholic beverages)	Fermentation	Cabbage Soya (soybean) Rice	None	D/I
XIX	Pickling	Brining or corning, the procedure of preserving food by anaerobic fermentation in salt solution	Cucumber Cabbage	Cucumbers→all vegetables	D/I

1) The crops mentioned are only examples giving some important crops for the respective processing procedure. The selection of the crop/RAC depends on the use pattern of the pesticide and its physical-chemical properties.

2) For further explanation see OECD Guideline on Magnitude of Residues in Processed Commodities (paragraph 31).
3) Category 1 procedures involve well-defined procedures typically practiced on a large industrial scale for major commodities. Most regulatory authorities consider studies for these procedures essential. A corresponding domestic use may also exist and be covered by the data from the industrial use.
4) Processing studies are necessary for both red and white wine grapes.
5) Although beer is not considered a primary processed commodity, being a multi-component product with multiple steps, it is an important processed commodity and the procedures to prepare it should be included in Category 1.
6) Category 2 procedures are a mixture of domestic (or home) and industrial procedures. These types of processing studies, while encouraged, are often considered optional by some regulatory authorities. The studies are particularly useful in refining dietary exposure assessments.
7) The procedures for marmalade, jam and jelly are not considered primary so a processing study may not be conducted; since the amount of sugar used in these procedures is significant (30-60% sugar), any calculations to determine a processing factor in place of an actual study should be based on 50% fruit content, or a processing factor of 0.5 for that step in the procedure (sugar addition step: fruit RAC residue X 0.5 = marmalade residue).
8) Animal RAC processing conducted only if a veterinary use (direct animal treatment) is requested.
9) No extrapolations are possible as each commodity contains a different percentage of water.

12. When processing factors derived by extrapolation result in intake levels above the ADI and/or ARfD (or their equivalent), additional studies using the same processing procedure on the crops of concern may be conducted in order to further refine the dietary exposure assessment.

Literature

(1) FAO Plant Production and Protection, Report 2004 (Paper 178): Pesticide Residues in Food, Rome, Italy 2004.

(2) FAO Plant Production and Protection, Report 2005 (Paper 183): Pesticide Residues in Food, Rome, Italy 2005.

(3) FAO Plant Production and Protection, Report 2006 (Paper 187): Pesticide Residues in Food, Rome, Italy 2006.

(4) OECD (2007). Guidance Document on the Definition of Residues. Environment, Health and Safety Publications. Series on Testing and Assessment No. 63 and Series on Pesticides No. 31, OECD, Paris 2006.

(5) OECD (2008). OECD Guideline for the Testing of Chemicals 508. Magnitude of Residues in Processed Commodities. In preparation.

(6) Scott Taylor et al, *Food Research International*, Vol 30, No. 5, 365- 370 (1997).

(7) Container Handbook: German marine insurers.

(8) Canadian Grain Commission, Canada Export Quality Data, 2004 – 2006.

(9) C. Trostle, Texas Agricultural Extension Service, *NuSun Mid-Oleic Oilseed Sunflower Yield vs Conventional…,* 2001.

(10) P. Laaniste et al, *Agronomy Research*, 2 92), 83 – 86 (2004).

(11) Harbans Bhardwaj, Virginia Cooperative Extension, *Crop and Soil Environmental News*, 03/1998.

(12) R. W. Gesch et al, Seed Yield and Oil Content of Cuphea as Affected by Harvest Date, *Agronomy Journal*, 04/27/2005.

(13) United States Environmental Protection Agency (1996). OPPTS Test Guidelines, Series 860: Residue Chemistry Test Guidelines, OPPTS 860.1520 Processed Food/Feed, EPA Report 712-C-96-184, Washington, D.C. http://www.epa.gov/pesticides/science/guidelines.htm.

ANNEX

Details concerning possible processed commodities and their procedures for reference only

This annex provides users with a compilation of processed commodities important for the calculation of dietary exposure of humans and animals. For this reason, commodities from the OECD feed table as well as major processed commodities used as foods are included. It is not intended to give a complete list of all processed commodities from all crops under all circumstances. Intermediates and by-products from cooking such as processing water are not included, as mass balances are not required for studies on magnitude of residues in processed commodities. This does not imply, however, that there is no need to analyze such products. Situations may occur where it is necessary to check such products to explain unexpected results.

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
Citrus fruit group	Citrus fruit	Peel			I	Residues field trial data
Citrus fruit group	Citrus fruit	Pulp			I	Residues field trial data
Citrus fruit group	Citrus fruit	Juice	12		II	
Citrus fruit group	Citrus fruit	pomace, wet (water content to be reported)			II	
Citrus fruit group	Citrus fruit	dried pulp	91		XVI	
Citrus fruit group	Citrus fruit	meal			II	
Citrus fruit group	Citrus fruit	molasses	67		II	
Citrus fruit group	Citrus fruit	marmelade			IV	
Citrus fruit group	Citrus hybrids	peel			I	Residues field trial data
Citrus fruit group	Citrus hybrids	pulp			I	Residues field trial data
Citrus fruit group	Citrus hybrids	juice			II	
Citrus fruit group	Citrus hybrids	dried pulp			XVI	
Citrus fruit group	Citrus hybrids	oil			Xa	
Citrus fruit group	Grapefruit	peel			I	Residues field trial data

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
Citrus fruit group	Grapefruit	pulp			I	Residues field trial data
Citrus fruit group	Grapefruit	juice	11		II	
Citrus fruit group	Grapefruit	dried pulp	89		XVI	
Citrus fruit group	Grapefruit	oil			Xa	
Citrus fruit group	Kumquats	juice			II	edible peel
Citrus fruit group	Lemon	peel			I	Residues field trial data
Citrus fruit group	Lemon	pulp			I	Residues field trial data
Citrus fruit group	Lemon	juice	19		II	
Citrus fruit group	Lemon	dried pulp			XVI	
Citrus fruit group	Lemon	oil			Xa	
Citrus fruit group	Lime	peel			I	Residues field trial data
Citrus fruit group	Lime	pulp			I	Residues field trial data
Citrus fruit group	Lime	juice	10		II	
Citrus fruit group	Lime	dried pulp			XVI	
Citrus fruit group	Lime	oil			Xa	
Citrus fruit group	Orange, sour	peel	28		I	Residues field trial data
Citrus fruit group	Orange, sour	pulp			I	Residues field trial data
Citrus fruit group	Orange, sour	juice	12		II	
Citrus fruit group	Orange, sour	dried pulp			XVI	
Citrus fruit group	Orange, sour	dried			XVI	
Citrus fruit group	Orange, sour	oil			Xa	
Citrus fruit group	Orange, sweet	peel	28		I	Residues field trial data

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
Citrus fruit group	Orange, sweet	pulp			I	Residues field trial data
Citrus fruit group	Orange, sweet	juice	12		II	
Citrus fruit group	Orange, sweet	dried pulp			XVI	
Citrus fruit group	Orange, sweet	dried			XVI	
Citrus fruit group	Orange, sweet	oil			Xa	
Citrus fruit group	Tangelo	peel			I	Residues field trial data
Citrus fruit group	Tangelo	pulp			I	Residues field trial data
Citrus fruit group	Tangelo	juice			II	
Citrus fruit group	Tangelo	dried pulp			XVI	
Citrus fruit group	Tangerine	peel			I	Residues field trial data
Citrus fruit group	Tangerine	pulp			I	Residues field trial data
Citrus fruit group	Tangerine	juice	13		II	
Citrus fruit group	Tangerine	dried pulp			XVI	
Tree nut group	Tree nut	Roasted/fried nut			IX	
Tree nut group	Tree nut	oil			Xa,b	
Tree nut group	Almond	oil			Xa,b	
Tree nut group	almond, tropical	oil			Xa,b	
Tree nut group	Cashew	oil			Xa,b	
Tree nut group	Filbert	oil			Xa,b	
Tree nut group	Pecan	oil			Xa,b	
Tree nut group	Walnut	oil			Xa,b	
Tree nut – coconut – group	Coconut	coconut milk			II	
Tree nut – coconut – group	Coconut	oil			Xa,b	
Tree nut – coconut –	Coconut	copra (dried meat)	94		XVI	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
group						
Stone fruit group	Stone fruit	canned			III	
Stone fruit group	Stone fruit	juice			II	
Stone fruit group	Stone fruit	jam/jelly			IV	
Stone fruit group	Apricot	dried fruit	69 (RAC 14)	4.9	XVI	
Stone fruit group	Apricot	juice			II	
Stone fruit group	Cherries	juice			II	
Stone fruit group	Cherry, sweet	dried fruit			XVI	
Stone fruit group	Cherry, sweet	juice			II	
Stone fruit group	Cherry, tart	dried fruit			XVI	
Stone fruit group	Cherry, tart	juice			II	
Stone fruit group	Nectarine	juice			II	
Stone fruit group	Peach	dried fruit	69		XVI	
Stone fruit group	Peach	juice			II	
Stone fruit group	Plum	washed plum			IV	
Stone fruit group	Plum	juice	19.00		II	
Stone fruit group	Plum	plum puree			IV	
Stone fruit group	Plum/prune dried	dried fruit	70 (72) (RAC 20)	3.5	XVI	
Pome fruit group	Pome fruit	canned			III	
Pome fruit group	Pome fruit	juice			II	
Pome fruit group	Pome fruit	pomace, wet (water content to be			II	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
		reported)				
Pome fruit group	Apple	juice	12		II	
Pome fruit group	Apple	pomace, wet	40		II	
Pome fruit group	Apple	applesauce			IV	
Pome fruit group	Apple	dried	68 (RAC 17)	4.0	XVI	
Pome fruit group	Crab apple	jelly			IV	
Pome fruit group	Pear	dried fruit	73 (RAC 16)	4.6	XVI	
Pome fruit group	Pear	juice			II	
Pome fruit group	Mayhaw	jelly			IV	
Berries group	Berries	canned			III	
Berries group	Berries	juice			II	
Berries group	Berries	jam/jelly			IV	
Berries group	Blackberry	juice			II	
Berries group	Blueberry	dried fruit			XVI	
Berries group	Blueberry	juice			II	
Berries group	Currant	dried fruit			XVI	
Berries group	Currant	jam/jelly			IV	
Berries group	currant, black	juice			II	
Berries group	Raspberry	juice			II	
Berries – strawberry – group	Strawberry	juice			II	
Berries – grape – group	Grape	juice	16		II	
Berries – grape – group	Grape	pomace, wet (water content to be reported)			II	
Berries – grape – group	Grape	oil			Xa,b	
Berries – grape – group	Grape	raisin	85 (RAC 18)	4.7	XVI	
Berries – grape – group	grape, wine	must			V	
Berries – grape	grape, wine	wine			V	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
– group						
Berries – grape – group	grape, wine	pomace, wet (water content to be reported)			V	
Berries – other – group	Acerola	juice			II	
Berries – other – group	aronia berry	juice			II	
Berries – other – group	Cranberry	dried fruit			XVI	
Berries – other – group	Cranberry	juice			II	
Berries – other – group	Cranberry	jelly			IV	
Miscellaneous fruit group	Fruit	canned			III	
Miscellaneous fruit group	Fruit	juice			II	
Miscellaneous fruit group	Fruit	dried fruit			XVI	
Miscellaneous fruit – inedible peel – group	Fruit	peel			I	Residues field trial data
Miscellaneous fruit – inedible peel – group	Fruit	pulp			I	Residues field trial data
Miscellaneous fruit – edible peel – group	Date	dried fruit			XVI	
Miscellaneous fruit – edible peel – group	Fig	dried fruit	74 (76) (RAC 22)	3.4	XVI	
Miscellaneous fruit – edible peel – group	Starfruit	dried fruit			XVI	
Miscellaneous fruit – inedible peel – group	Kiwifruit	juice			II	
Miscellaneous fruit – inedible peel – group	Mango	dried fruit			XVI	
Miscellaneous	Mango	juice			II	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
fruit – inedible peel – group						
Miscellaneous fruit – inedible peel – group	Papaya	dried fruit			XVI	
Miscellaneous fruit – inedible peel – group	Papaya	juice			II	
Miscellaneous fruit – inedible peel – group	Passion fruit	juice			II	
Miscellaneous fruit – inedible peel – group	Pineapple	dried fruit			XVI	
Miscellaneous fruit – inedible peel – group	Pineapple	juice	14		II	
Miscellaneous fruit – inedible peel – group	Pineapple	process residue	25		II	
Miscellaneous fruit – inedible peel – group	Banana	peel			I	Residues field trial data
Miscellaneous fruit – inedible peel – group	Banana	pulp			I	Residues field trial data
Miscellaneous fruit – inedible peel – group	Banana	dried fruit	86		XVI	
Miscellaneous fruit – inedible peel – group	Banana	Fried (banana chips)			IX	
Miscellaneous fruit – inedible peel – group	Banana	juice			II	
Miscellaneous fruit – inedible peel – group	Plantain	peel			I	Residues field trial data
Miscellaneous fruit – inedible peel – group	Plantain	pulp			I	Residues field trial data
Miscellaneous fruit – inedible peel – group	Plantain	dried fruit			XVI	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
Miscellaneous fruit – inedible peel – group	Plantain	flour			IV	
Miscellaneous fruit – inedible peel – group	Lychee	dried fruit	78		XVI	Litchi
	Persimmon	dried fruit			XVI	
Vegetables		microwaved vegetables			XVIII	All vegetables that can be cooked
Bulb vegetable group	Garlic	dried	41		XVI	
Bulb vegetable group	onions (silver skin)	pickled			VIII	
Root and tuber vegetable group	Carrot	peeled			VI	
Root and tuber vegetable group	Carrot	cooked			VI	
Root and tuber vegetable group	Carrot	juice			VII	
Root and tuber vegetable group	Carrot	canned			VIII	
Root and tuber vegetable group	Ginger	oil			X	
Root and tuber vegetable group	Potato	peeled potatoes			VI	
Root and tuber vegetable group	Potato	wet peel	23		VI	
Root and tuber vegetable group	Potato	boiled potatoes			VI	
Root and tuber vegetable group	Potato	microwaved/ boiled potatoes (unpeeled)			IX/XVIII	
Root and tuber vegetable group	Potato	baked potatoes			IX	
Root and tuber vegetable group	Potato	fried potatoes			IX	
Root and tuber vegetable group	Potato	crisps			IX	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
Root and tuber vegetable group	Potato	chips	97		IX	
Root and tuber vegetable group	Potato	granules/flakes	93 (RAC 20)	4.6	IX	
Root and tuber vegetable group	Potato	process waste			IX	
Root and tuber vegetable group	Potato	ensiled			XIV	
Root and tuber vegetable group	Potato	starch			XI	
Root and tuber vegetable group	Potato	dried pulp			XVI	
Root and tuber vegetable group	Potato	potato protein			XI	
Root and tuber vegetable group	beet, sugar	raw juice			XII	
Root and tuber vegetable group	beet, sugar	thick juice			XII	
Root and tuber vegetable group	beet, sugar	raw sugar			XII	
Root and tuber vegetable group	beet, sugar	refined sugar (white sugar)	99		XII	
Root and tuber vegetable group	beet, sugar	press water			XII	
Root and tuber vegetable group	beet, sugar	pressed pulp			XII	
Root and tuber vegetable group	beet, sugar	pulp (wet)			XII	
Root and tuber vegetable group	beet, sugar	dried pulp	90 (88)		XVI	
Root and tuber vegetable group	beet, sugar	molasses	78		XII	
Root and tuber vegetable group	beet, sugar	ensiled pulp			XIV	
Fruiting vegetable group – solanacea	Tomato	Washed and peeled tomatoes			VIII	
Fruiting vegetable group – solanacea	Tomato	canned			VIII	
Fruiting vegetable group	Tomato	Sun dried	85 (RAC 6.1)	14	IX	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
– solanacea						
Fruiting vegetable group – solanacea	Tomato	juice	6		VII	
Fruiting vegetable group – solanacea	Tomato	wet pomace	25		VII	
Fruiting vegetable group – solanacea	Tomato	dried pomace	92 (RAC 25, wet pomace)	3.7	XVI	
Fruiting vegetable group – solanacea	tomato	paste	30		VII	
Fruiting vegetable group – solanacea	Tomato	puree	11		VII	
Fruiting vegetable group – solanacea	pepper, bell = sweet pepper	dried	85		XVI	
Fruiting vegetable group – solanacea	pepper, nonbell = chili pepper	dried			XVI	
Fruiting vegetable group – cucurbit vegetable group – edible peel	Cucurbits, edible peel	canned			VIII	
Fruiting vegetable group – cucurbit vegetable group – edible peel	Cucurbits, edible peel	pickled			XIX	
Fruiting vegetable group – cucurbit vegetable group – inedible peel	Cucurbits, inedible peel	peel			I	Residues field trial data
Fruiting vegetable group – cucurbit vegetable group – inedible peel	Cucurbits, inedible peel	pulp			I	Residues field trial data
Fruiting vegetable group	Watermelon	juice			VII	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
– cucurbit vegetable group – inedible peel						
Brassica vegetables	Brassica vegetables	Inner and outer leaves			VI	
Brassica vegetables	Brassica vegetables	cooked			VI	
Brassica vegetables	head cabbage (white)	Sauerkraut			XVII	
Brassica vegetables	head cabbage (white)	sauerkraut juice			XVII	
Leafy vegetable (except brassica vegetables)	Spinach	cooked spinach			VI	
Leafy vegetable (except brassica vegetables)	herbs, fresh	dried leaves			XVI	
Leafy vegetable (except brassica vegetables)	Chervil	dried leaves			XVI	
Herbs and spices group	basil seed	oil			Xa,b	
Herbs and spices group	cardamom seed	oil			Xa,b	
Herbs and spices group	clove seed	oil			Xa,b	
Herbs and spices group	cumin seed	oil			Xa,b	
Herbs and spices group	dill seed	oil			Xa,b	
Herbs and spices group	mustard seed	oil			Xa,b	
Herbs and spices group	poppy seed	oil			Xa,b	
Herbs and spices group	borage seed	oil			Xa,b	
Stem vegetables	Stem vegetable	cooked			VI	
Stem vegetables	Asparagus	peeled and cooked			VI	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
		asparagus				
Stem vegetables	Asparagus	canned			VIII	
Stem vegetables	Celery	juice			VII	Leafy vegetable
Stem vegetables	Crambe	meal			IX	
Legume vegetable group	Legume vegetable	cooked			VI	
Legume vegetable group	Legume vegetable	canned			VIII	
Pulses group	Chickpea	flour			XI	
Legume vegetable group	Guar	meal			XI	
Legume vegetable group	peas without pods	canned			VIII	
Oilseeds vegetable group	Soybean	flour	94		XI	
Oilseeds group	Soybean	soy milk			IX	
Oilseeds group	Soybean	tofu			IX	
Oilseeds group	Soybean	soy sauce			XVII	
Oilseeds group	Soybean	miso			XVII	
Fungi	Mushrooms	canned			VIII	
Fungi	Shiitake	dried			XVI	
Pulses	Pulses	cooked			VI	
Hop group	Hop	dried cones			-	Residue field trials data
Hop group	Hop	extracted hops			V	
Hop group	Hop	beer			V	
Hop group	Hop	brewer's yeast			V	
Hop group	Hop	hops draff			V	
Oilseeds	Oilseed	Crude oil			Xa,b	
Oilseeds	Oilseed	refined oil			Xa,b	
Oilseeds	Oilseed	solvent-extraction/ pressing: meal or cake			Xa,b	
Oilseeds	Canola = rape seed	refined oil			Xa,b	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
Oilseeds	Canola = rape seed	meal	89		Xa,b	
Oilseeds	Cotton	undelinted seed			-	Residue field trials data
Oilseeds	Cotton	refined oil			Xa,b	
Oilseeds	Cotton	hulls	90		Xa,b	
Oilseeds	Cotton	meal	89		Xa,b	
Oilseeds	Cotton	gin byproducts			Xa,b	
Oilseeds	evening primrose	oil			Xa,b	
Oilseeds	flaxseed/linseed	oil			Xa,b	
Oilseeds	flaxseed/linseed	meal	89		Xa,b	
Oilseeds	Peanut	refined oil			Xa,b	
Oilseeds	Peanut	peanut butter			Xa,b	
Oilseeds	Peanut	meal	89		Xa,b	
Oilseeds	Palm	oil			Xa,b	
Oilseeds	Palm	kernel meal			Xa,b	
Oilseeds	rape seed	refined oil			Xa,b	
Oilseeds	rape seed	meal	90		Xa,b	
Oilseeds	Safflower	refined oil			Xa,b	
Oilseeds	Safflower	meal	92		Xa,b	
Oilseeds	Sesame	oil			Xa,b	
Oilseeds	Sesame	meal	92		Xa,b	
Oilseeds	Soybean	refined oil			Xa,b	
Oilseeds	Soybean	hulls	90		Xa,b	
Oilseeds	Soybean	meal	92		Xa,b	
Oilseeds	Soybean	aspirated grain fraction			Xa,b	
Oilseeds	Soybean	pollard			Xa,b	
Oilseeds	Sunflower	refined oil			Xa,b	
Oilseeds	Sunflower	meal	92		Xa,b	
Cereal grain group	Barley	pearled barley (pot barley)	90		XI	
Cereal grain group	Barley	flour	88		XI	
Cereal grain group	Barley	bran	90		XI	
Cereal grain group	Barley	brewing malt			V	
Cereal grain group	Barley	malt sprouts			V	
Cereal grain	Barley	beer			V	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
group						
Cereal grain group	Barley	brewer's grain, dried			V	
Cereal grain group	Barley	brewer's yeast			V	
Cereal grain group	Buckwheat	flour	89		XI	
Cereal grain group	Corn	flour - wet milling			XI	
Cereal grain group	Corn	flour - dry milling			XI	
Cereal grain group	Corn	bran			XI	
Cereal grain group	Corn	gluten			XI	
Cereal grain group	Corn	gluten feed meal			XI	
Cereal grain group	Corn	middlings			XI	
Cereal grain group	Corn	starch			XI	
Cereal grain group	Corn	germ (residues in germ necessary in order to answer questions concerning residues in oil derived from the germ)			Xc	
Cereal grain group	Corn	refined oil	99		Xc	
Cereal grain group	Corn	meal	90		Xc	
Cereal grain group	Corn	aspirated grain fraction			XI	
Cereal grain group	Corn	hominy meal			Xc	
Cereal grain group	Corn	milled byproducts			XI	
Cereal grain group	Corn	silage			XIV	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
Cereal grain group	corn, sweet	canned			VIII	
Cereal grain group	corn, sweet	cannery waste			VIII	
Cereal grain group	Millet	flour	89		XI	
Cereal grain group	millet, proso	flour	89		XI	
Cereal grain group	Oat	groats/ rolled oats (oat flakes)	91		XI	
Cereal grain group	Oat	flour	89		XI	
Cereal grain group	Oat	bran	94		XI	
Cereal grain group	Oat	Oat husk and oat dust			XI	
Cereal grain group	Rice	husked rice			XI	
Cereal grain group	Rice	hulls			-	see forage, fodder and straw of cereal grain group
Cereal grain group	Rice	polished rice	90		XI	
Cereal grain group	Rice	flour			XI	
Cereal grain group	Rice	bran	91		XI	
Cereal grain group	Rice	sake			V	
Cereal grain group	Rice	cooking			VI	
Cereal grain group	Rye	bran	91		XI	
Cereal grain group	Rye	flour	91		XI	
Cereal grain group	Rye	gluten			XI	
Cereal grain group	Rye	gluten feed meal			XI	
Cereal grain group	Rye	middlings			XI	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
Cereal grain group	Rye	starch			XI	
Cereal grain group	rye	rye germ			XI	
Cereal grain group	rye	whole-meal flour			XI	
Cereal grain group	rye	whole-grain bread			XI	
Cereal grain group	sorghum	flour	88		XI	
Cereal grain group	sorghum	aspirated grain fraction			XI	
Cereal grain group	triticale	bran			XI	
Cereal grain group	triticale	flour	89		XI	
Cereal grain group	wheat	bran	90		XI	
Cereal grain group	wheat	flour	89		XI	
Cereal grain group	wheat	germ	88		XI	
Cereal grain group	wheat	middlings	89		XI	
Cereal grain group	wheat	shorts	88		XI	
Cereal grain group	wheat	aspirated grain fraction			XI	
Cereal grain group	wheat	gluten			XI	
Cereal grain group	wheat	gluten feed meal			XI	
Cereal grain group	wheat	milled byproducts			XI	
Cereal grain group	wheat	starch			XI	
Cereal grain group	wheat	wheat germ			XI	
Cereal grain group	wheat	Whole-meal flour			XI	
Cereal grain group	wheat	whole-grain bread			XI	
Cereal grain group	cereals	Distillers grain/residues			V	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
		, fresh				
Cereal grain group	cereals	Distillers grain/residues, dried			V	
Tea	tea	dried leaves			XVI	
Tea	tea	instant	9		XIII	
Tea	tea	infusion			XIII	
Herbal teas	Herbs (roots, flowers, leaves, others)	infusion			XIII	
Cacao	cacao bean	roasted bean			XIII	
Cacao	cacao bean	cocoa powder	96		XI	
Cacao	cacao bean	chocolate	98		none	
Coffee	coffee bean	roasted bean			XIII	
Coffee	coffee bean	instant	97		XIII	
Coffee	coffee bean	coffee			XIII	
No group name	asafetida	oil			Xa,b	
No group name	bean, tonka	oil			Xa,b	
No group name	ben moringa seed	oil			Xa,b	
No group name	buffalo gourd	oil			Xa,b	
No group name	buffalo gourd	meal			Xa,b	
No group name	castorbean	oil			Xa,b	
No group name	castorbean	meal			Xa,b	
No group name	cuphea	oil			Xa,b	
No group name	cuphea	meal			Xa,b	
No group name	euphorbia	oil			Xa,b	
No group name	jojoba	oil			Xa,b	
No group name	jojoba	meal			Xa,b	
No group name	olive	Oil, virgin			Xa,b	
No group name	peppermint	oil			Xa,b	
No group name	spearmint	oil			Xa,b	
No group name	maple, sugar	syrup			XII	
No group name	sorghum, sweet	syrup	77		XII	
No group name	sugarcane	refined sugar	99		XII	
No group name	sugarcane	molasses (blackstrap)	76		XII	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
No group name	sugarcane	bagasse			XII	
No group name	Stevia (*Stevia rebaudiana*)	stevioside			XII	
No group name	Chaya (*Cnidoscolus chayamansa*), tree spinach	leaves	20		-	Residue field trials data
Grass forage, fodder, and hay group	grass	hay	86 (RAC 20)	4.3	XVI	Residues field trial data
Grass forage, fodder, and hay group	grass	wet silage			XIV	
Grass forage, fodder, and hay group	grass	wilted silage			XIV	
Grass forage, fodder, and hay group	millet, foxtail	hay			XVI	Residues field trial data
Grass forage, fodder, and hay group	millet, Japanese	hay			XVI	Residues field trial data
Forage, fodder and straw of cereal grain group	cereal grain	Wet silage			XIV	
Forage, fodder and straw of cereal grain group	cereal grain	wilted silage			XIV	
Forage, fodder and straw of cereal grain group	barley	hay	88		XVI	Residues field trial data
Forage, fodder and straw of cereal grain group	millet	hay	85		XVI	Residues field trial data
Forage, fodder and straw of	millet, pearl	hay	85		XVI	Residues field trial data

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
cereal grain group						
Forage, fodder and straw of cereal grain group	millet, proso	hay	85		XVI	Residues field trial data
Forage, fodder and straw of cereal grain group	oat	hay	90		XVI	Residues field trial data
Forage, fodder and straw of cereal grain group	rice	hulls	91		XI	
Forage, fodder and straw of cereal grain group	teff	hay			XVI	Residues field trial data
Forage, fodder and straw of cereal grain group	triticale	hay			XVI	Residues field trial data
Forage, fodder and straw of cereal grain group	wheat	hay	88		XVI	Residues field trial data
Nongrass animal feed group	alfalfa	hay	89		XVI	Residues field trial data
Nongrass animal feed group	alfalfa	silage	38		XIV	
Nongrass animal feed group	alfalfa	meal			none	
Nongrass animal feed group	clover	hay	89		XVI	Residues field trial data
Nongrass animal feed group	clover	silage	28		XIV	
Nongrass animal feed	Crown vetch	hay	90		XVI	Residues field trial data

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
group						
Nongrass animal feed group	lespedeza	hay	88		XVI	Residues field trial data
Nongrass animal feed group	lupine	hay			XVI	Residues field trial data
Nongrass animal feed group	lupine seed	meal			none	
Nongrass animal feed group	sainfoin	hay			XVI	Residues field trial data
Nongrass animal feed group	trefoil	hay	85		XVI	Residues field trial data
Nongrass animal feed group	vetch	hay	85		XVI	Residues field trial data
Foliage of legume vegetable group	Legume vegetable	hay			XVI	Residues field trial data
Foliage of legume vegetable group	Legume vegetable	wet silage			XIV	
Foliage of legume vegetable group	Legume vegetable	wilted silage			XIV	
Foliage of legume vegetable group	cowpea	hay	88		XVI	Residues field trial data
Foliage of legume vegetable group	pea, field	hay	88		XVI	Residues field trial data
Foliage of legume vegetable group	pea, field	silage	34		XIV	
Foliage of legume vegetable group	peanut	hay	85		XVI	Residues field trial data
Foliage of legume vegetable group	peanut, perennial	hay			XVI	Residues field trial data

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
Foliage of legume vegetable group	soybean	hay	89		XVI	Residues field trial data
Foliage of legume vegetable group	soybean	silage	30		XIV	
No group name	Arrow leaf, balsam leaf	hay			XIV	Residues field trial data
No group name	black wattle	hay			XIV	Residues field trial data
No group name	crotolaria	hay			XIV	Residues field trial data
No group name	curly mesquite	hay			XIV	Residues field trial data
No group name	leucaena	hay			XIV	Residues field trial data
Fish		fish meal			XV	
Milk producing animals	Milk	Fresh skim milk			XV	
Milk producing animals	Milk	dried skim milk			XVI	
Milk producing animals	Milk	Pasteurized milk			XV	
Milk producing animals	Milk	butter			XV	
Milk producing animals	Milk	cheese			XV	
Milk producing animals	Milk	fresh whey			XV	
Milk producing animals	Milk	dry whey			XVI	
Bird's eggs	eggs	boiled			XV	
Bird's eggs	eggs	fried			XV	
Bird's eggs	eggs	poached			XV	
Poultry	meat	baked			XV	
Mammals	meat	baked			XV	
Fish	Meat	baked			XV	
Poultry	meat	fried			XV	

Group[1]	Raw agricultural commodity (RAC)	Processed fraction	% DM in processed commodity (% DM in RAC in brackets)[2]	Theoretical processing factor	Procedure[3]	Remarks
Mammals	meat	fried			XV	
Fish	Meat	fried			XV	
Mammals	meat	smoked			XV	
Fish	Meat	smoked			XV	

[1] crop groups not yet harmonised; changes necessary as soon as Codex revision is finalized

[2] US-EPA Data base

[3] types of core processing procedures:

I distribution in the edible / non edible portion (To be conducted as described in Field Trials Guideline)
II preparation of fruit juice
III preparation of canned fruit
IV preparation of other fruit products
V preparation of alcoholic beverages (fermentation, distillation)
VI cooking vegetables, pulses and grains in water (including steaming)
VII preparation of vegetable juice
VIII preparation of canned vegetable
IX miscellaneous preparation of other vegetable products
X preparation of oil (extraction, pressing, milling in case of maize)
Xa belongs to extraction, Xb belongs to pressing, Xc belongs to maize milling
XI distribution on milling
XII preparation of sugar
XIII infusions and extractions
XIV silage production
XV processing of products of animal origin including preparation of meat and fish (poaching, frying, baking, boiling) [for veterinary use (direct treatment) only]
XVI dehydration
XVII fermentation of soybeans, rice and others (except alcoholic beverages)
XVIII microwaving vegetable
XIX pickling

Literature concerning the Annex

Adams, C.F. 1975. Nutritive Value of American Foods in Common Units. USDA ARS Agricultural Handbook No. 456.

Ensminger, M.E., J.L. Oldfield, and W.W. Heinemann. 1990. Feeds and Nutrition. 2nd Edition. Ensminger Publishing Co., Clovis, CA.

Fortin, J. 1996. The Visual Food Encyclopedia. Macmillan Co., NY. 685 pp.

Gebhardt, S.E. and R. Matthews. 1986. Nutritive Value of Foods. USDA Human Nutrition Information Service. Home and garden Bulletin No. 72.

Matthews, R. and Y.Y. Garrison. 1975. Food Yields. Summary by Stages of Preparation Commonly Used. USDA ARS Handbook No. 102.

Markle, G.M., J.J. Baron, and Bernard A. Schneider. 1998. Food and Feed Crops of the United States. 2nd Edition. Meister Publishing Co., Willoughby, OH. 517 pp.

Ornamental Edibles. 1998. Catalog. San Jose, CA.

Pennington, J.A.T. 1998. Bowes and Church's Food Values of Portions Commonly Used. 7th Edition. Lippincott, NY.

Rubatzky, V.E. and M. Yamaguchi. 1997. World Vegetables. 2nd Edition. Chapman and Hall., NY. 843 pp.

Salunkhe, D.K. and S.S. Kadam. 1998. Handbook of Vegetable Science and Technology: Production, Composition, Storage, and Processing. Marcel Dekker, Inc., NY. 721 pp.

U.S. EPA. 1993. EPA Residue Chemistry Test Guidelines. Table 1. OPPTS 860.1000.

U.S. EPA. 1994. EPA Residue Chemistry Test Guidelines. Processed Food/Feed. OPPTS 860.1540.