SLOVENSKI STANDARD
SIST EN 15662:2018

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Nadomešča:
SIST EN 15662:2009

Hrana rastlinskega izvora - Večelementna metoda za določanje ostankov pesticidov z uporabo analize na osnovi GC in LC po delitvi in izpiranju acetonitrila z disperzivno SPE - Modularna metoda QuEChERS

Foods of plant origin - Multimethod for the determination of pesticide residues using GC- and LC-based analysis following acetonitrile extraction/partitioning and clean-up by dispersive SPE - Modular QuEChERS-method

Pflanzliche Lebensmittel - Multiverfahren zur Bestimmung von Pestizidrückständen mit GC und LC nach Acetonitril-Extraktion/Verteilung und Reinigung mit dispersiver SPE - Modulares QuEChERS-Verfahren

Aliments d'origine végétale - Multiméthode de détermination des résidus de pesticides par analyse CG et CL après extraction/partition avec de l'acétonitrile et purification par SPE dispersive - Méthode modulaire QuEChERS

Ta slovenski standard je istoveten z: **EN 15662:2018**

ICS:

67.050	Splošne preskusne in analizne metode za živilske proizvode	General methods of tests and analysis for food products

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EUROPEAN STANDARD

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Foods of plant origin - Multimethod for the determination of pesticide residues using GC- and LC-based analysis following acetonitrile extraction/partitioning and clean-up by dispersive SPE - Modular QuEChERS-method

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This European Standard was approved by CEN on 27 December 2017.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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European foreword

This document (EN 15662:2018) has been prepared by Technical Committee CEN/TC 275 “Food analysis - Horizontal methods”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2018, and conflicting national standards shall be withdrawn at the latest by November 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15662:2008.

With the revised version, some amendments and improvements have been taken into consideration, notably:

— the more precise differentiation between feasible modes of operation (Table 1 to Table 5);

— the opportunity to report the applied modes of operation (e.g. extraction or clean-up modules) in a simple way;

— clear indications of approved modes of operation for particular commodities (Table 6);

— the optimization of extraction efficiency by longer extraction time;

— the specification of suitable parameters for the detection with UPLC-MS/MS and GC-MS/MS;

— new approaches for the quantitation of pesticide residues including a simplified procedure for the calculation of residue levels;

— references to the improved validation data for the method (see Table 7 and CEN/TR 17063);

— a list of abbreviations has been added in Annex C.

WARNING — The application of this standard may involve hazardous materials, operations and equipment. This standard does not claim to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard stipulates a method for the analysis of pesticide residues in foods of plant origin, such as fruits (including dried fruits), vegetables (including dried vegetables), cereals and many processed products thereof by using GC, GC-MS(/MS), and/or LC-MS(/MS). The method has been collaboratively studied on a large number of commodity/pesticide combinations. Precision data are summarized in CEN/TR 17063. Guidelines for calibration are outlined in CEN/TS 17061.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CEN/TS 17061:2017, *Foodstuffs - Guidelines for the calibration and quantitative determination of pesticide residues and organic contaminants using chromatographic methods*

3 Principle

The homogeneous sample is extracted with the help of acetonitrile. Samples with low water content (<80 %) require the addition of water before the initial extraction to get a total of approximately 10 g of water. After addition of magnesium sulfate, sodium chloride and buffering citrate salts, the mixture is shaken intensively and centrifuged for phase separation. An aliquot of the organic phase is cleaned-up by dispersive solid phase extraction (D-SPE) employing bulk sorbents as well as magnesium sulfate for the removal of residual water. Following clean-up with amino-sorbents (e.g. primary secondary amine sorbent, PSA) and if necessary graphitized carbon black (GCB) or octadecylsilane (ODS), extracts are acidified by adding a small amount of formic acid, to improve the storage stability of certain base-sensitive pesticides. The final extract can be directly employed for GC- and LC-based analysis. Suitable detectors for GC analysis are mass-selective detectors (MS or MS/MS) with unit or high mass resolution or other GC detectors, such as flame photometric detector, FPD, and electron capture detector, ECD. For the analysis with LC hyphenations with tandem mass-spectrometry (LC-MS/MS) or high resolution mass-spectrometry are particularly suitable. Quantification may be performed using an internal standard, which is added to the test portion before the first extraction, but this is not mandatory. Details for calibration, see CEN/TS 17061.

4 Preparation and storage of the samples

4.1 General

Sample processing and storage procedures should be demonstrated to have no significant effect on the residues present in the test sample (sometimes also called “analytical sample”). Processing should also ensure that the test sample is homogeneous enough so that portion to portion (sub-sampling) variability is acceptable. If a single analytical portion is unlikely to be representative of the test sample, larger or replicate portions shall be analysed, to provide a better estimate of the true value. The degree of comminution should support a quantitative residue extraction.

4.2 Laboratory sample

A laboratory sample that is wholly or extensively spoiled or degraded should not be analysed. When possible, prepare laboratory samples immediately after arrival and in any event, before any significant physical or chemical changes have taken place. If a laboratory sample cannot be prepared without delay, it should be stored under appropriate conditions to keep it fresh and to avoid deterioration. Dried or similarly processed samples should be analysed within their stated shelf life.

4.3 Partly-prepared test sample

For preparation of the partly-prepared test sample take only the portion of the laboratory sample to which the maximum residue level applies. No further plant-parts shall be removed.

The reduction of the laboratory sample shall be carried out in such a way that representative portions are obtained (e.g. by sub-division into four and selection of opposite quarters). For samples of small units (e.g. small fruits such as berries, legumes, cereals), the sample shall be thoroughly mixed before weighing out the partly-prepared test sample. When the samples are made up of larger units, take wedge-shaped sections (e.g. melons) or cross sections (e.g. cucumbers) that include the skin (outer surface) from each unit [1].

4.4 Test sample

From each partly-prepared test sample, any parts that would cause difficulties with the homogenization process should be removed. In the case of stone fruits, the stones shall be removed. This is the test sample. A record of the plant-parts that have been removed shall be kept. Precautions should be taken to avoid any losses of juice or flesh. Calculation of the residue shall be based on the mass of the original test sample (including the stones where it is necessary).

Where the homogeneity of the test sample is not sufficient or the extraction of residues may be significantly compromised due to large particle sizes, intensive comminution should be performed using appropriate means. This is possible at ambient temperature, if separation of flesh and juice or degradation of target pesticides does not occur to a significant extent. Comminution of samples in a frozen state can significantly reduce losses of chemically labile pesticides and usually results in smaller particle sizes and a higher degree of homogeneity. Cutting the samples coarsely (e.g. 3 cm x 3 cm) with a knife and putting them into the freezer (e.g. –18 °C, overnight) prior to comminution facilitates processing. Processing can be also assisted and improved by cryogenic milling (using dry ice or liquid nitrogen) by keeping the temperature below 0 °C. Especially in the case of fruits and vegetables, cryogenic milling is much more effective at homogenizing commodities that have tough skins (e.g. tomatoes or grapes) compared to milling at ambient temperature. Given the fact that non-systemic pesticides often predominantly occur on the skin, cryogenic milling significantly reduces sub-sampling variability. When processing test samples at low temperatures, condensation caused by high humidity should be avoided. Residual carbon dioxide should be allowed to sufficiently dissipate so that its contribution to weigh of the sample will be negligible.

4.5 Test portion

Individual test portions each sufficient for one analysis should be taken from the comminuted test sample. These test portions should be analysed immediately. If test portions cannot be analysed directly, the test sample or the test portions shall be frozen until required. If it is noted that homogeneity of the test sample has been compromised during storage, the test sample shall be mixed before taking test portions to ensure that homogeneity has been re-established.

5 Procedure

Extraction of samples is specified through modules E1 to E9. Extraction is usually followed by a clean-up of the obtained raw extracts using the modules C1 to C5. Clean-up steps may be omitted if interference of matrix load during analysis with chromatographic methods described in modules D1 to D6 is not evident. In some cases clean-up could be replaced by dilution of the raw extracts (module C0). Prior to the determination usually some stabilization of the extracts is performed (module S1). All modules are described in detail in Annex A. Complementary information is given in Annex B.

Tables 1 to 4 contain brief descriptions of the modules as well as application notes and examples of use. For the calculation of residue concentrations in the sample extracts all of the calibration procedures and quantification methods described in options Q1 to Q7 (Table 5) are applicable. Preferred combinations of modules concerning the extraction of samples and clean-up of raw extracts are listed in Table 6 for a multitude of commodities (raw as well as processed).

Table 1 — Extraction (E)

module	Description	Preferred application	Examples
Extraction without hydrolysis			
E1	A test portion of 10 g without any addition of water is extracted with acetonitrile	Plant material and edibles with high water content (≥80 %)	Fruit and vegetables, juices
E2	10 g test portion is extracted by 10 ml acetonitrile after addition of (a) 0,6 ml or (b) 0,2 ml sodium hydroxide solution.	Plant material and edibles with high water content (≥80 %) and high acid content	(a) Lemons, lime, red current (b) raspberry, blackberry
E3	A test portion of 10 g is completed with (a) 2,5 ml or (b) 4,5 ml of water and then extracted with acetonitrile	Plant material and edibles with intermediate water content (> 40 % and < 80 %)	(a) Bananas, root and tuber vegetables (potatoes, yam, parsnip) (b) Bread, fresh dates, chestnuts
E4	Test sample is homogenized with water and a test portion of 13,5 g of the homogenate is extracted with acetonitrile.	Plant material and edibles with low water content (15 % to 40 %)	Dried fruit und similar commodities
E5	A test portion of 5 g is completed with 10 ml of water and then extracted with acetonitrile	Plant material and edibles with very low water content (<15 %) and honey	Cereal grain and products thereof, honey
E6	A test portion of 5 g is completed with 6 ml of water and then extracted with acetonitrile	Plant material and edibles with intermediate water content (>40 % to 80 %) and high matrix load or high oil content (>5 %)	Garlic, avocados
E7	A test portion of 2 g is completed with 10 ml of water and then extracted with acetonitrile	Plant material and edibles with very low water content (<15 %) and high matrix load as well as freeze-dried products	Spices, coffee, tobacco, tea, lentils, freeze-dried fruit
Extraction with hydrolysis			
E8	Hydrolysis of esters and conjugates of acidic pesticides in the slurry of 10 g sample in acetonitrile followed by extraction with acetonitrile (proposed reference test method for alkaline hydrolysis)	Plant material and edibles with neutral or acidic pH and high water content (≥80 %)	Fruit and vegetables, juices, lemons
E9	Hydrolysis of esters and conjugates of acidic pesticides in the slurry of 2 g to 5 g sample in acetonitrile followed by extraction with acetonitrile (proposed reference test method for alkaline hydrolysis)	Plant material and edibles with low water content	Cereal grain and products thereof, garlic, spices, coffee, tobacco, tea, lentils, freeze-dried fruit

Table 2 — Clean-up (C)

Module	Description	Preferred application	Examples
C0	No clean-up	Base-sensitive and acidic pesticides (pK_a < 5) that interact with the amino-sorbent (PSA) used in modules C2 to C5, analysis of extracts with low matrix-load	Cucumber, apples, sufficiently diluted raw-extracts
C1	Freezing-out	Removal of co-extracted fat (even in combination with further clean-up steps, e.g. C2, C3, C5)	Oranges, lemons, cereal grain
C2	Dispersive SPE with amino-sorbent (PSA)	Clean-up of raw-extracts prior to the determination of basic and neutral pesticides	Standard-procedure for any commodity not shown separately
C3	Dispersive SPE with a larger amount of amino-sorbent (PSA)	Clean-up of raw-extracts of foods of plant origin with high matrix-load prior to the determination of basic and neutral pesticides	Raw-extracts from modules E5 (e.g. cereal grain and products thereof) and E7 (e.g. coffee, tea, dried herbs, spices)
C4	Dispersive SPE with a mixture of amino-sorbent and silica-based reversed phase sorbent (PSA/ODS)	Simultaneous clean-up of raw-extracts and removal of co-extracted fat	Citrus fruit, cereal grain and products thereof, avocados, olives
C5	Dispersive SPE with a mixture of amino-sorbent and graphitized carbon black (PSA/GCB)	Clean-up of intensely coloured raw-extracts prior to the determination of basic and neutral pesticides	Iceberg lettuce, head lettuce, rocket salad

Table 3 — Extract stabilization (S)

Module	Description	Preferred application	Examples
S0	No extract stabilization	acid-labile analytes	Flazasulfurone, Mesosulfurone, Tribenurone, Triflusulfurone
S1	Extract stabilization with formic acid	base-labile and acid-stable analytes	Majority of analytes

Table 4 — Detection (D)

Module	Description	Preferred application	Examples
D1	LC-MS/MS	Extracts from modules E1 to E9 subsequently cleaned-up with modules C0 to C5	Analytes ionizable by ESI/APCI in extracts from any commodity
D2	LC-HR-MS	Extracts from modules E1 to E9 subsequently cleaned-up with modules C0 to C5	Analytes ionizable by ESI/APCI in extracts from any commodity
D3	GC-MS/MS	Extracts from modules E1 to E7 subsequently cleaned-up with modules C0 to C5	Analytes ionizable by EI/PCI/NCI in extracts from any commodity
D4	GC-MS (incl. ITD and TOF)	Extracts from modules E1 to E7 subsequently cleaned-up with modules C0 to C5	Analytes ionizable by EI/PCI/NCI in extracts from commodities with low matrix-load
D5	GC-FPD	Extracts from modules E1 to E7 subsequently cleaned-up with modules C1 to C5	Organophosphorus and sulfur-containing compounds
D6	GC-ECD	Extracts from modules E1 to E7 subsequently cleaned-up with modules C1 to C5	Organochlorine compounds

The gas chromatographic determination with single quadrupole mass spectrometric detection (preferred in SIM mode), with ion trap detectors and with time-of-flight mass spectrometric detection (independent of the MS resolution) is suited for all analytes. GC-MS analysis without clean-up is only possible if the extracts are highly diluted (module C0).

Table 5 — Quantification (Q)

Option	Description	Preferred application	Reference
Q1	Quantification using external standards in solvent	Determinations where matrix-effects are assumed to be negligible	see CEN/TS 17061:2017, 4.4.2 to 4.4.5
Q2	Quantification using external standards in matrix	Determinations where matrix-effects shall be considered	see CEN/TS 17061:2017, 4.3 and 4.4.2 to 4.4.5
Q3	Quantification using a procedural internal standard and standards in solvent	Determinations where matrix-effects are assumed to be negligible	see CEN/TS 17061:2017, 4.5.2
Q4	Quantification using standard addition to the final extract	Determinations where matrix effects shall be considered and suitable blank matrices are not available	see CEN/TS 17061:2017, 4.6.2
Q5	Quantification using a procedural internal standard and standards in matrix or isotope-labelled internal standards	Determinations where matrix-effects shall be considered for compensation of low recovery	see CEN/TS 17061:2017, 4.3, 4.5.2 and 4.5.3
Q6	Quantification using standard addition to the sample	Determinations where matrix-effects shall be considered without availability of blank (control) samples or incomplete extractions of the analyte occur	see CEN/TS 17061:2017, 4.6.3
Q7	Quantification by calibration of the entire procedure	Determinations where matrix-effects shall be considered or incomplete extractions of the analyte occur	see CEN/TS 17061:2017, 4.7

Table 6 — Preferred combinations of extraction and clean-up modules for particular commodities

Commodity	Extraction (E)	Description (E)[a]	Clean-up (C)	Description (C)[b]	Clean-up (C altern.)	Description (C altern.)[b]
Apple juice	E1	10 g / 0 ml	C2	PSA 25	—	—
Apple pomace	E1	10 g / 0 ml	C2	PSA 25	—	—
Apples	E1	10 g / 0 ml	C2	PSA 25	—	—
Apples, dried	E4	500 g / 850 ml	C2	PSA 25	—	—
Apricots	E1	10 g / 0 ml	C2	PSA 25	—	—
Apricots, dried	E4	500 g / 850 ml	C2	PSA 25	—	—
Apricot juice	E1	10 g / 0 ml	C2	PSA 25	—	—
Asparagus	E1	10 g / 0 ml	C2	PSA 25	—	—
Aubergine	E1	10 g / 0 ml	C2	PSA 25	—	—
Avocado	E6	5 g / 6 ml	C1 + C2	Freeze out + PSA 25	C4	PSA 25 + C18 25
Bananas	E3a	10 g / 2,5 ml	C2	PSA 25	—	—
Bananas, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	—	—
Basil	E1	10 g / 0 ml	C5b	PSA 25 + GCB 7,5	—	—
Bean seeds, fresh	E3a	10 g / 2,5 ml	C2	PSA 25	—	—
Beans, dried	E5	5 g / 10 ml	C2	PSA 25	—	—
Beetroot	E1	10 g / 0 ml	C2	PSA 25	—	—
Blackberries	E2b	10 g / NaOH 2	C2	PSA 25	—	—
Blackberries, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	C3a	PSA 50
Blueberries	E1	10 g / 0 ml	C2	PSA 25	—	—
Blueberries, dried (14 % water)	E4	500 g / 850 ml	C2	PSA 25	—	—
Blueberries, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	C3a	PSA 50
Bread (34 % to 43 % water)	E3b	10 g / 4,5 ml	C2	PSA 25	—	—
Breadfruits (70 % water)	E3a	10 g / 2,5 ml	C2	PSA 25	—	—
Broccoli	E1	10 g / 0 ml	C2	PSA 25	—	—
Carrot	E1	10 g / 0 ml	C5a	PSA 25 + GCB 2,5	—	—
Carrots, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	C5a	PSA 25 + GCB 2,5
Cauliflower	E1	10 g / 0 ml	C2	PSA 25	—	—
Celeriacs/turnip rooted celeries	E1	10 g / 0 ml	C2	PSA 25	C5a	PSA 25 + GCB 2,5
Celery	E1	10 g / 0 ml	C2	PSA 25	—	—
Celery, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	C5b	PSA 25 + GCB 7,5

Commodity	Extraction (E)	Description (E)[a]	Clean-up (C)	Description (C)[b]	Clean-up (C altern.)	Description (C altern.)[b]
Cereal flour	E5	5 g / 10 ml	C1 + C3a	Freeze out + PSA 50	C4	PSA 25 + C18 25
Cereal grain	E5	5 g / 10 ml	C1 + C3a	Freeze out + PSA 50	C4	PSA 25 + C18 25
Cereal semolina	E5	5 g / 10 ml	C 1 + C 3a	Freeze out + PSA 50	C4	PSA 25 + C18 25
Cereals flakes	E5	5 g / 10 ml	C1 + C3a	Freeze out + PSA 50	C4	PSA 25 + C18 25
Cherries	E1	10 g / 0 ml	C2	PSA 25	—	—
Chestnuts (45 % to 52 % water)	E3b	10 g / 4,5 ml	C2	PSA 25	—	—
Chinese cabbages	E1	10 g / 0 ml	C2	PSA 25	—	—
Chives	E1	10 g / 0 ml	C5b	PSA 25 + GCB 7,5	—	—
Chives, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	C5b	PSA 25 + GCB 7,5
Coconut, fresh	E6	5 g / 6 ml	C2	PSA 25	—	—
Coffee beans	E7	2 g / 10 ml	C3b	PSA 25	—	—
Coriander	E1	10 g / 0 ml	C5b	PSA 25 + GCB 7,5	—	—
Corn, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	—	—
Corn, fresh	E3a	10 g / 2,5 ml	C2	PSA 25	—	—
Courgettes	E1	10 g / 0 ml	C2	PSA 25	—	—
Cress	E1	10 g / 0 ml	C5b	PSA 25 + GCB 7,5	—	—
Cucumber	E1	10 g / 0 ml	C2	PSA 25	—	—
Currants	E2a	10 g / NaOH 1	C2	PSA 25	—	—
Currants, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	—	—
Currants juice	E2a	10 g / NaOH 1	C2	PSA 25	—	—
Dates, dried	E4	500 g / 850 ml	C2	PSA 25	—	—
Dates, fresh (50 % to 60 % water)	E3b	10 g / 4,5 ml	C2	PSA 25	—	—
Durian	E6	5 g / 6 ml	C1 + C2	Freeze out + PSA 25	C4	PSA 25 + C18 25
Escaroles/broad-leaved endives	E1	10 g / 0 ml	C5a	PSA 25 + GCB 2,5	—	—
Figs, dried	E4	500 g / 850 ml	C2	PSA 25	—	—
Fungi cultivated	E1	10 g / 0 ml	C2	PSA 25	—	—
Fungi, dried (e.g. Shitake, boletus)	E5	5 g / 10 ml	C2	PSA 25	—	—
Garlic (59 % water)	E6	5 g / 6 ml	C2	PSA 25	—	—
Ginger (79 % water)	E6	5 g / 6 ml	C2	PSA 25	—	—

Commodity	Extraction (E)	Description (E)[a]	Clean-up (C)	Description (C)[b]	Clean-up (C altern.)	Description (C altern.)[b]
Ginkgo seeds (55 % water)	E3b	10 g / 4,5 ml	C2	PSA 25	—	—
Globe artichokes	E1	10 g / 0 ml	C2	PSA 25	—	—
Gooseberrys	E2b	10 g / NaOH 2	C2	PSA 25	—	—
Grape leaves	E3a	10 g / 2,5 ml	C2	PSA 25	—	—
Grape leaves	E1	10 g / 0 ml	C5b	PSA 25 + GCB 7,5	—	—
Grapefruit	E1	10 g / 0 ml	C1 + C2	Freeze out + PSA 25	—	—
Grapes	E1	10 g / 0 ml	C2	PSA 25	—	—
Head brassica	E1	10 g / 0 ml	C2	PSA 25	—	—
Head lettuce	E1	10 g / 0 ml	C5a	PSA 25 + GCB 2,5	—	—
Honey	E5	5 g / 10 ml	C2	PSA 25	—	—
Honeydew melon	E1	10 g / 0 ml	C2	PSA 25	—	—
Horseradish	E3a	10 g / 2,5 ml	C2	PSA 25	—	—
Jackfruit (74 % water)	E3a	10 g / 2,5 ml	C2	PSA 25	—	—
Kales	E1	10 g / 0 ml	C5b	PSA 25 + GCB 7,5	—	—
Kiwi	E1	10 g / 0 ml	C2	PSA 25	—	—
Kohlrabi	E1	10 g / 0 ml	C2	PSA 25	—	—
Lamb's lettuces	E1	10 g / 0 ml	C5b	PSA 25 + GCB 7,5	—	—
Leek	E1	10 g / 0 ml	C2	PSA 25	—	—
Leek, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	—	—
Lemon grass, fresh (71 % water)	E6	5 g / 6 ml	C2	PSA 25	—	—
Lemon juice	E2a	10 g / NaOH 1	C2	PSA 25	—	—
Lemons	E2a	10 g / NaOH 1	C1 + C2	Freeze out + PSA 25	—	—
Lentils, dried	E5	5 g / 10 ml	C2	PSA 25	—	—
Lime juice	E2a	10 g / NaOH 1	C2	PSA 25	—	—
Limes	E2a	10 g / NaOH 1	C1 + C2	Freeze out + PSA 25	—	—
Lotus roots (79 % water)	E3a	10 g / 2,5 ml	C2	PSA 25	—	—
Lotus seeds	E3a	10 g / 2,5 ml	C2	PSA 25	—	—
Lotus seeds, dried (14 % water)	E5	5 g / 10 ml	C2	PSA 25	—	—
Mandarins	E1	10 g / 0 ml	C1 + C2	Freeze out + PSA 25	—	—
Mango	E1	10 g / 0 ml	C5a	PSA 25 + GCB 2,5	—	—

Commodity	Extraction (E)	Description (E)[a]	Clean-up (C)	Description (C)[b]	Clean-up (C altern.)	Description (C altern.)[b]
Mango, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	C5b	PSA 25 + GCB 7,5
Mirabelle	E1	10 g / 0 ml	C2	PSA 25	—	—
Nectarines	E1	10 g / 0 ml	C2	PSA 25	—	—
Olives	E6	5 g / 6 ml	C1 + C2	Freeze out + PSA 25	C4	PSA 25 + C18 25
Onions	E1	10 g / 0 ml	C2	PSA 25	—	—
Oranges	E1	10 g / 0 ml	C1 + C2	Freeze out + PSA 25	—	—
Papaya	E1	10 g / 0 ml	C2	PSA 25	—	—
Parsley	E1	10 g / 0 ml	C5b	PSA 25 + GCB 7,5	—	—
Parsnip	E3a	10 g / 2,5 ml	C2	PSA 25	—	—
Peaches	E1	10 g / 0 ml	C2	PSA 25	—	—
Peaches, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	—	—
Pears	E1	10 g / 0 ml	C2	PSA 25	—	—
Peas, dried	E5	5 g / 10 ml	C2	PSA 25	—	—
Peas, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	—	—
Pepper, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	C5b	PSA 25 + GCB 7,5
Pepper, green, yellow	E1	10 g / 0 ml	C2	PSA 25	—	—
Pepper, red	E1	10 g / 0 ml	C5b	PSA 25 + GCB 7,5	—	—
Peppermint, fresh	E3a	10 g / 2,5 ml	C5b	PSA 25 + GCB 7,5	—	—
Peppermint, fresh (78 % water)	E6	5 g / 6 ml	C2	PSA 25	—	—
Pineapples	E1	10 g / 0 ml	C2	PSA 25	—	—
Pineapples, freeze-dried	E7	2 g / 10 ml	C2	PSA 25	—	—
Plantain	E3a	10 g / 2,5 ml	C2	PSA 25	—	—
Plums	E1	10 g / 0 ml	C2	PSA 25	—	—
Plums, dried	E4	500 g / 850 ml	C2	PSA 25	—	—
Potatoes	E1	10 g / 0 ml	C2	PSA 25	—	—
Potatoes	E3a	10 g / 2,5 ml	C2	PSA 25	—	—
Pumpkins	E1	10 g / 0 ml	C5a	PSA 25 + GCB 2,5	—	—
Quinces	E1	10 g / 0 ml	C2	PSA 25	—	—
Radish	E1	10 g / 0 ml	C2	PSA 25	—	—
Raisins	E4	500 g / 850 ml	C2	PSA 25	—	—
Raspberries	E2b	10 g / NaOH 2	C2	PSA 25	—	—
Red cabbage	E1	10 g / 0 ml	C2	PSA 25	—	—
Rhubarb	E2b	10 g / NaOH 2	C2	PSA 25	—	—
Rhubarb juice	E2b	10 g / NaOH 2	C2	PSA 25	—	—