



International Atomic Energy Agency
Analytical Quality Control Services
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REFERENCE SHEET

REFERENCE MATERIAL

IAEA-359

TRACE AND MINOR ELEMENTS IN CABBAGE

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Recommended Values
(Based on dry weight)

Element	Recommended Value mg/kg	95% Confidence Interval mg/kg	N*
Ba	11.0	10.5 – 11.5	31
Cu	5.67	5.49 – 5.85	85
Fe	148	144.1 – 151.9	110
K	32500	31810 - 33190	84
Mg	2160	2110 – 2210	63
Mn	31.9	31.3 – 32.5	96
Sr	49.2	47.8 – 50.6	46
Zn	38.6	37.9 – 39.3	122

* Number of accepted laboratory means which were used to calculate the recommended values and confidence intervals.

Information Values
(Based on dry weight)

Element	Information Value mg/kg	95% Confidence Interval mg/kg	N*
As	0.10	0.096 - 0.104	25
Ca	18500	17990 - 19010	82
Cd	0.12	0.115 - 0.125	57
Cr	1.3	1.24 - 1.36	83
Hg	0.013	0.011 - 0.015	30
Na	580	567 - 601	61
Ni	1.05	1.00 - 1.10	43
Se	0.12	0.109 - 0.131	34

* Number of accepted laboratory means which were used to calculate the information values and confidence intervals.

The values listed above were established on the basis of statistically valid results submitted by laboratories which had participated in four international intercomparison exercises organized between 1992/1993. The details concerning the criteria for qualification as a recommended or an information value can be found in the report IAEA/AL/123 "Intercomparison runs for the determination of trace and minor elements in cabbage material IAEA-359" [1]. This report is available free of charge upon request.

Intended Use

This sample is intended to be used as a reference material for the measurement of trace and minor elements in vegetable matrices. It can also be used as a quality control material for the assessment of a laboratory's analytical work, for the validation of analytical methods and for quality assurance within a laboratory.

Origin and preparation of the material

IAEA 359 Cabbage (*Brassica oleracea* var. *Sabauda*) was grown from seed in the vicinity of the Agency's laboratory in Seibersdorf, Austria. Since this material was originally intended for use as an agrochemical reference material, the seeds were treated with Lindane and Aziprotryne and during the growth of the crop, it was treated with a further eight agrochemical compounds (Metazachlor, Propachlor, Desmetryne, Endosulfan, Bromophos, (Lindane), Fluazifop-butyl, Bitertanol and Trifluralin) [2]. Approximately 6000 Kg of the cabbage was harvested by hand and then cut using an agricultural cutting machine. The stems were removed by hand and 2200 Kg of the material was available for further processing.

The raw material was oven dried at 40 °C for several days and then stored in black polythene bags (about 285 Kg). The dried cabbage was ground in an impact pulveriser mill to pass through a 300 µm sieve and extruded into polythene bags. This coarse fraction was then further processed in an air jet mill, resulting in a particle size below 50 µm. Once air jet milled, the material was placed in a large plastic drum and thoroughly mixed by continuous rotation for a 24 hour period. The material was then bottled in acid washed brown glass bottles which were sealed with a polythene cap. Each bottle contained approximately 30 g of the product. The sealed bottles were sterilised at 25 KGy using a ⁶⁰Co source, to confer stability by inhibiting any microbial action in the product.

Homogeneity

Since the original purpose of IAEA 359 was as a reference material for agrochemical residues, homogeneity testing at the time of production was focused on these analytes and was conducted at a relatively high intake mass of 1 g [2]. In parallel, a limited range of inorganic analytes was also tested using X-ray Fluorescence (XRF), Instrumental Neutron Activation Analysis (INAA) and Atomic Absorption Spectrometry (AAS), with sample intake masses in the range 0.1 to 1.0 g. The results indicated that the component of uncertainty due to the heterogeneity of the material was less than or equal to five percent [2] for trace and minor elements.

No systematic attempt was made to evaluate the minimum representative sample size for IAEA-359. However, subsequent analyses by INAA and XRF indicated that the material could be considered to be homogeneous for Br, Co, Cs, Fe, Rb and Zn with intake masses at or above 150 mg.

Dry weight determination

All recommended and information values are expressed on a dry weight basis. Therefore the dry weight must be determined at the time of analysis, using separate sub-samples of 500 mg dried to constant weight in a drying oven set to 100 °C. Subsequent weighings should differ by less than 5 mg.

Instructions for use

The recommended minimum sample size for analysis is 150 mg. Analysts are reminded to take appropriate precautions in order to avoid contaminating the remaining material in the bottle. It is recommended that the material be stored in a dark place, below 25°C.

Legal disclaimer

The IAEA makes no warranties, expressed or implied, with respect to the data contained in this reference sheet and shall not be liable for any damage that may result from the use of such data.

References

- [1] Campbell M. J., Radecki Z., Trinkl A. and Burns K. I., Intercomparison runs for the determination of trace and minor elements in cabbage material IAEA-359. IAEA/AL/123, IAEA, Vienna, Austria, November 1999.
- [2] Zeisler R., Strachnov V., Perschke H. and Dekner R., The preparation of a cabbage candidate reference material to be certified for residues of agrochemicals. Fresenius J. Anal. Chem. **345** (1993) 202-206.

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