National Research Council Canada | Conseil national de recherches Canada

Certificate of Analysis

Certified Reference Material

VITA-1

Low-level Multivitamin Certified Reference Material for Minerals and Vitamins

VITA-1 is part of a suite of multivitamin Certified Reference Materials (CRMs) from the National Research Council of Canada (NRC). VITA-1 is a low-level multivitamin CRM that is certified for minerals and vitamins. Each unit of VITA-1 consists of 20 individually packed tablets. Together with VITB-1, this CRM is intended for the calibration of procedures and the development of methods for the determination of minerals and vitamins in multivitamin materials or similar matrices.

The following tables show those constituents for which certified, reference and information values have been established for this low-level multivitamin certified reference material (CRM). The expanded uncertainty (U_{CRM}) in the certified value is equal to $U = ku_c$ where u_c is the combined standard uncertainty calculated according to the JCGM Guide [1] and k is the coverage factor. A coverage factor of two (2) was applied which corresponds to approx. 95 % confidence. It is intended that U_{CRM} accounts for every aspect that reasonably contributes to the uncertainty of the measurement. All values are expressed on the actual mass of the sample. No dry weight correction was performed.

Table 1: Mass fractions and expanded uncertainty (k = 2) for elements and element species in VITA-1

Element/compound	Mass fraction, mg/kg	Mass fraction, µg/tablet	Type of value
arsenic (b, c, e)	0.046 ± 0.008	0.118 ± 0.021	certified
boron (a, c, d)	84 ± 10	215 ± 26	certified
bromine (c)	0.28 ± 0.08	0.73 ± 0.21	reference
cadmium (a)	0.02	0.05	information
calcium (b, c, d, m)	28 600 ± 4400	73 400 ± 11 400	certified
chlorine (c)	222 ± 32	571 ± 83	reference
chromium (a, c, d, m)	10.2 ± 0.6	26.1 ± 1.6	certified
chromium picolinate (as Cr) (f, m)	9.7 ± 0.4	25 ± 1.1	reference
cobalt (b, c)	0.573 ± 0.046	1.471 ± 0.122	certified
copper (a, c, d, m)	98 ± 4	252 ± 11	certified
iodine (c, m)	29 ± 12	75 ± 31	reference
iron (a, c, d, m)	3560 ± 280	9140 ± 740	certified
lead (a, b, c)	0.064 ± 0.008	0.164 ± 0.021	certified

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Element/compound	Mass fraction, mg/kg	Mass fraction, µg/tablet	Type of value
magnesium (b, c, d, m)	18 500 ± 1600	47 500 ± 4200	certified
manganese (b, c, d, m)	389 ± 20	1000 ± 55	certified
mercury (a, b)	< 0.004	< 0.010	certified
molybdenum (a, c, d)	18.1 ± 2	46.5 ± 5.2	certified
phosphorus (b, c, d)	19 000 ± 800	48 800 ± 2300	certified
potassium (b, c, d, m)	12 100 ± 1200	31 000 ± 3100	certified
selenium (a, c, d)	4.2 ± 1.4	10.8 ± 3.6	certified
selenomethionine (as Se) (f)	3.0 ± 1.2	7.8 ± 3.1	reference
sodium (c)	1000	2560	information
strontium (c)	9	22	information
zinc (a, c, d, m)	2340 ± 100	6020 ± 280	certified

Table 2: Mass fractions and expanded uncertainty (*k* = 2) for vitamins in VITA-1

Vitamin	Mass fraction, mg/kg	Mass fraction, µg/tablet	Type of value
ascorbic acid (j, m)	11 190	28 740	information
alpha tocopherol (k, m)	1760	4530	information
biotin (h, l, m)	7.9 ± 0.4	20.2 ± 1.1	reference
beta carotene (j, m)	60	160	information
cyanocobalamin (f, g, h, l)	1.3 ± 0.2	3.3 ± 0.5	reference
ergocalciferol (i)	0.06	0.15	information
folic acid (h, l, m)	76 ± 6	195 ± 16	reference
lutein (j)	0.7	1.7	information
niacinamide (h, j, m)	3840 ± 172	9860 ± 480	reference
pantothenic acid (h, j, m)	1940 ± 120	4990 ± 320	reference
phylloquinone (i, m)	6	15	information
pyridoxine HCl (h, j, m)	390 ± 40	1010 ± 100	reference
retinol acetate (i)	50	120	information
riboflavin (h, j, m)	342 ± 24	878 ± 64	reference
thiamine HCl (h, j, m)	290 ± 40	750 ± 100	reference

Coding

The coding refers to the instrumental method of analyte determination.

- **a** Isotope dilution inductively-coupled plasma mass spectrometry (ID-ICP-MS)
- **b** Standard addition inductively-coupled plasma mass spectrometry (ICP-MS)
- **c** Inductively-coupled plasma mass spectrometry (ICP-MS)
- **d** Standard addition Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
- **e** Hydride generation ICP-MS
- **f** Standard addition liquid chromatography ICP-MS (LC-ICP-MS)
- **g** Isotope dilution liquid chromatography-tandem mass spectrometry (ID-LC-MS/MS)

- **h** Liquid chromatography-tandem mass spectrometry (LC-MS/MS)
- **i** Liquid chromatography mass spectrometry (LC-MS)
- **j** High-performance liquid chromatography ultraviolet detection (HPLC-UV)
- **k** High-performance liquid chromatography fluorescence detection (HPLC-FLD)
- **l** Microbiological assay
- **m** Gravimetry

Certified values

Certified values are considered to be those for which the NRC has the highest confidence in accuracy and that all known and suspected sources of bias have been taken into account and are reflected in the stated expanded uncertainties. Certified values are the best estimate of the true value and uncertainty.

Reference values

Reference values are those for which insufficient data are available to provide a comprehensive estimate of uncertainty.

Information values

Information values are those for which insufficient data are available to provide any estimate of uncertainty.

Intended use

This CRM is not intended for human consumption; it is intended for the calibration of procedures and the development of methods for the determination of minerals and vitamins in multivitamin materials or similar matrices. A minimum sample mass of 2.57 g (one tablet) is recommended.

Storage

It is recommended that VITA-1 to be stored in a dark, +4 °C temperature environment or lower and the trilaminate foil pouches opened immediately prior to use.

Instructions for use

A unit of VITA-1 consists of a box with 20 tablets individually packaged in trilaminate foil pouches which serve as a barrier to the light and moisture. Trilaminate foil pouches should only be opened immediately prior to use. The CRM is sensitive to light, so caution should be taken to avoid any light exposure. Each tablet weighs approximately 2.57 g. The moisture content is estimated at 7.3 mg/g (19 mg per tablet). It should be noted that if the tablets are ground, the protective coating is fractured and the vitamins may degrade. In this case, sample must be analyzed immediately.

Preparation of material

VITA-1 is a low-level multivitamin tablet that was prepared by a commercial manufacturer according to pharmaceutical standards. The material contains vitamins (both water soluble and fat soluble vitamins), dietary minerals and other nutritional elements and was pressed into tablets, film-coated and individually packed in a trilaminate foil pouch. Each tablet is oval shaped with an average thickness of 11.5 mm.

Stability

A short-term stability study was conducted using the isochronous approach to simulate potential elevated temperatures experienced during shipping. No measurable degradation was observed during this period. The long-term stability was initially assessed over a period of two years at storage conditions. No change in measured mass fraction was observed over this period as long as the material is stored in appropriate conditions. Uncertainty components for long and short-term stability were thus considered negligible and are thus not included in the uncertainty budget.

Homogeneity

The material was tested for homogeneity at the NRC. Results from sub-samples (single tablets) were evaluated using DerSimonian-Laird random effects model and included in the calculation of the certified values [2].

Uncertainty

Included in the overall combined uncertainty estimate (u_c) are uncertainties in the batch characterization (u_{char}), uncertainties related to possible between-tablet variation (u_{hom}), and uncertainties related to inconsistency between the various measurement methods (u_{method}). The latter is estimated as the heterogeneity in the random effects model fitted to the results of individual methods, also known as the dark uncertainty [3,4]. **Metrological traceability**

Results presented in this certificate are traceable to the SI through gravimetrically-prepared standards of established purity and international measurement intercomparisons. As such, VITA-1 serves as suitable reference materials for laboratory quality assurance programs, as outlined in ISO/IEC 17025.

Quality Management System (ISO 17034, ISO/IEC 17025)

This material was produced in compliance with the NRC Metrology Quality Management System, which conforms to the requirements of ISO 17034 and ISO/IEC 17025. The Metrology Quality Management System supporting NRC Calibration and Measurement Capabilities, as listed in the *Bureau international des poids et mesures* (BIPM) Key Comparison Database (kcdb.bipm.org/), has been reviewed and approved under the authority of the Inter-American Metrology System (SIM) and found to be in compliance with the expectations of the *Comité international des poids et mesures* (CIPM) Mutual Recognition Arrangement. The SIM approval is available upon request.

Updates

Users should ensure that the certificate they have is current. For updates, please refer to doi.org/10.4224/crm.2018.vita-1

References

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Cited by

A list of scientific publications citing VITA-1 CRM can be found at doi.org/10.4224/crm.2018.vita-1

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VITA-1

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Approved by: Patricia Grinberg

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This Certificate is only valid if the corresponding material was obtained directly from the NRC or an Authorized Reseller.

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