

Certified Reference Materials Program

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National Research
Council Canada

Conseil national
de recherches Canada

Canada



CRMs.... Several “Firsts”

- 1981: CRM for trace elements in seawater (NASS-1)
- 1989: material for MeHg speciation (TORT/DOLT/DORM)
- 1989: second generation RM (LUTS-1)
- 1993: natural matrix for dioxins, furans and PCBs (CARP-1)
- 1995: AsB speciation (DORM-2)
- 2005: SELM-1 selenomethionine in yeast
- 2011: Mercury isotope ratio / atomic weight CRM
- 2014: CRM for cellulose nanocrystal

reflects our R & D initiatives

What is new at NRC: Inorganic CRMs

Environmental CRMs

AQUA-1 drinking water

trace elements, MMAs, DMAs,
TMAs

PRON-1 River prawn

trace elements & AsBet

SQID-1 Cuttlefish

trace elements, AsBet & MeHg



What is new at NRC: Inorganic CRMs Food & Nutrition

trace elements

BOVM-1	Bovine Muscle
BRAN-1	Corn Bran RM
CORS-1	Corn Starch RM
DUWF-1	Durum Wheat Flour RM
EGGS-1	Egg Powder RM
GLUT-1	Wheat Gluten RM
POTS-1	Potato Starch RM
REDS-1	Hard Red Spring Wheat Flour RM
SOWW-1	Soft Winter Wheat Flour RM



What is new at NRC: Inorganic CRMs Food & Nutrition

BARI-1	Baby cereal coarse rice flour	total As, Cd, Hg, Pb, iAs, DMA, MMA
KINO-1	Quinoa flour	trace elements
VITA-1	low-level multivitamin	trace elements, major, SeMet, Cr picolinate, vitamins
VITB-1	high-level multivitamin	trace elements, major, SeMet, Cr picolinate, vitamins
SPIN-1	spinach powder	nitrate/ trace metals

What is new at NRC: Inorganic CRMs - Speciation

Food & Nutrition

As Speciation

- BARI-1** Baby cereal coarse rice flour (DMA, MMA)
- DORM-4** Fish protein (AsBet)
- PRON-1** River Prawn (AsBet)
- SQID-1** Cuttlefish (AsBet)
- TORT-3** Lobster Hepatopancreas (AsBet)

Hg speciation

- DOLT-5** Dogfish liver (MeHg (reference value))
- DORM-4** Fish protein (MeHg)
- TORT-3** Lobster Hepatopancreas (MeHg)

Se speciation

- VITA-1** low-level multivitamin (SeMet)
- VITB-1** high-level multivitamin (SeMet)

What is new at NRC: Inorganic CRMs Isotopic Reference Material CRMs

ABET-1

natural arsenobetaine bromide

BBET-1

^{13}C labelled ($[\text{}^{13}\text{CH}_2]\text{-}$) arsenobetaine bromide

CBET-1

^{13}C labelled ($[\text{}^{13}\text{CO}]\text{-}$) arsenobetaine bromide

IRIS-1

natural osmium



What is new at NRC: Inorganic CRMs Isotopic Reference Material CRMs

- **BEET-1** beet sugar carbon isotope delta values
- **FRUT-1** fructose carbon isotope delta values
- **GALT-1** galactose carbon isotope delta values



What is new at NRC: Organic CRMs

Natural products

GINX-1

North American ginseng root extract

GIPS-1

Ginseng Root

MIGS-1

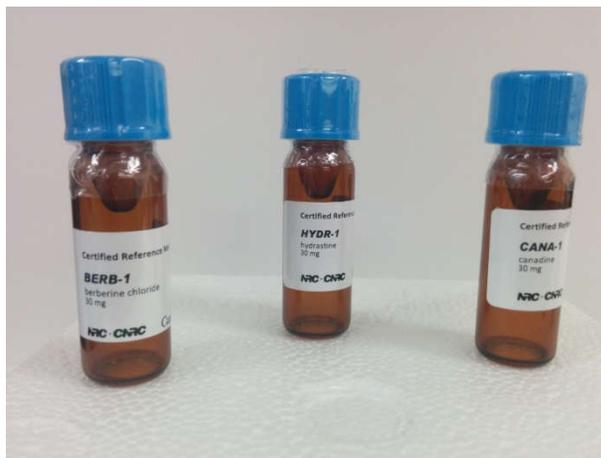
Multi-Component Ginsenoside Calib. Solution



What is new at NRC: Organic CRMs

Natural products

BERB-1	Berberine Chloride
CANA-1	Canadine
HYDR-1	Hydrastine



What is new at NRC: Organic CRMs

Amino acids

APRO-1

L-proline (0.9957 ± 0.0050 g/g)

ALEU-1

L-leucine (0.9930 ± 0.0040 g/g)

AMET-1

L-methionine (0.9989 ± 0.0034 g/g)

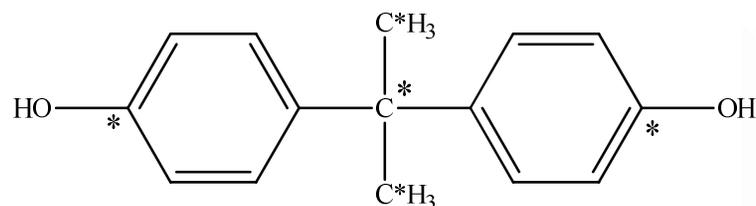
APHE-1

L-proline (0.9957 ± 0.0040 g/g)

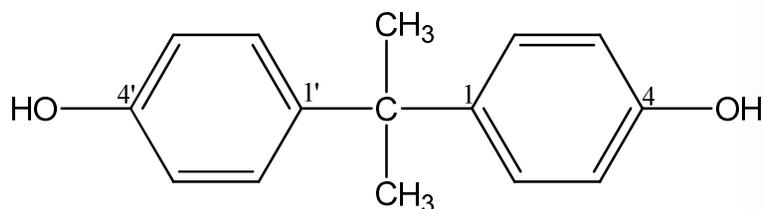


What is new at NRC: Organic CRMs

Bisphenol A (BPA)



BPAL-1
[¹³C₅]-bisphenol A



BPAN-1
Bisphenol A



What is new at NRC: Organic CRMs Ginsenosides

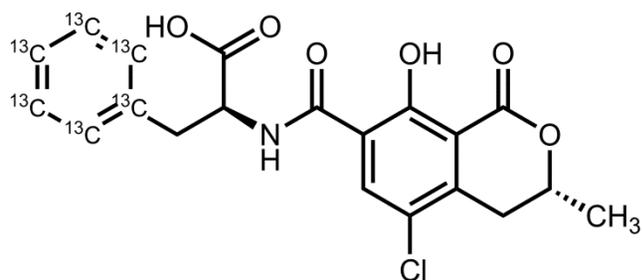
MIGS-1: Mixed ginsenoside calibration solution

GINX-1: North American Ginseng Root Extract
Ginsenosides and Metals

GIPS-1: North American Ginseng Root Powder
Pesticides, Trace Metals & other Constituents

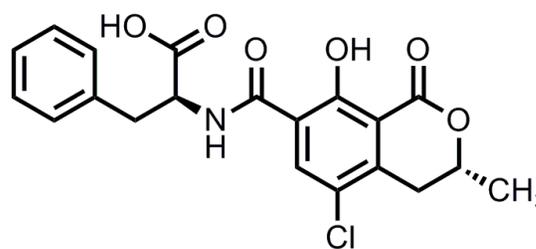


What is new at NRC: Organic CRMs Ochratoxin A Calibration Solutions



OTAL-1
4.89 ± 0.16 µg/g

[¹³C₆]-OTA in acetonitrile with 0.1% formic acid

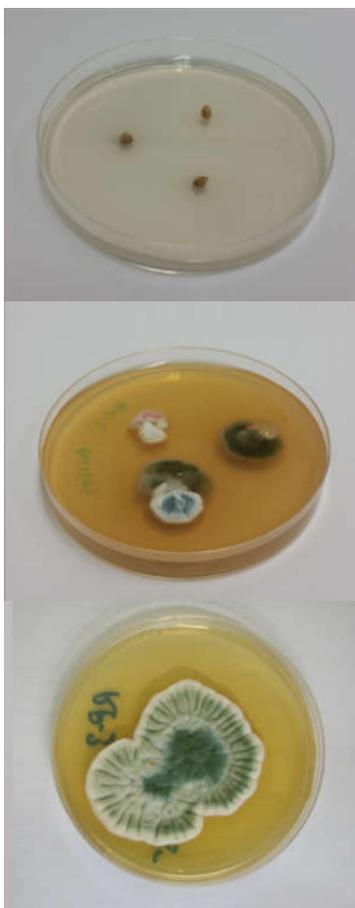


OTAN-1
11.03 ± 0.38 µg/g

OTA in acetonitrile with 0.1% formic acid

What is new at NRC: Organic CRMs

Mycotoxin Matrix CRM



OTA contaminated wheat



MYCO-1



OTA: $4.05 \pm 0.82 \mu\text{g}/\text{kg}$

What is new at NRC: Organic CRMs Veterinary Drug Matrix CRM



Heifer selection and dosing



Euthanization
Grinding



Homogenization
Bottling



BOTS-1

8 analytes certified

What is new: Nanomaterials CRMs

SWCNT-1 (purified SWCNT)



Certified Reference Material

SWCNT-1 Single-Wall Carbon Nanotube Certified Reference Material

This Certified Reference Material is primarily intended for use in the validation of procedures and development of methods for the determination of trace metals in carbon nanotubes or those of a similar matrix. It has been gamma sterilized to support studies of environmental health and safety and nanotoxicology. SWCNTs have been identified as an engineered nanomaterial for which thorough characterization is needed for assessments of environmental, health and safety testing [1]. Parameters of interest include elemental/molecular composition, specific surface area, surface chemistry, particle size and distribution, morphology/shape/form, surface charge and crystal structure, amongst other variables. SWCNT-1 serves as a stable and homogeneous representative test material to foster development and validation of international consensus-based standards to further rigorous physico-chemical characterization of such materials [2].

A unit of SWCNT-1 CRM consists of a bottle containing nominally 100 mg of SWCNT material under an Ar atmosphere.

Certified Mass Fraction Values: Certified mass fraction values are considered to be those for which 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.

Table 1 summarizes those trace metals for which certified values have been established for this material. The expanded uncertainty (U_{CRM}) in the certified value is equal to $U_{CRM} = k u_c$ where u_c is the combined standard uncertainty calculated according to the JCGM Guide [3] and k is the coverage factor. It is intended that U_{CRM} accounts for every aspect that reasonably contributes to the uncertainty of the measurement [4]. A coverage factor of 2 was applied for all elements. The table below lists certified values for SWCNT-1, expressed on a dry mass basis.

Table 1. Certified Mass Fraction Values for SWCNT-1

Element	Mass Fraction	Units
Co (a,b)	16.2 ± 1.0	g/kg
Ni (b,c)	14.5 ± 0.8	g/kg
Mo (b,c)	7.1 ± 0.7	g/kg
Fe (b,c)	2.2 ± 0.2	g/kg
Pb (c)	7.0 ± 1.0	mg/kg
Hg (c)	< 10 ²	mg/kg

^a For the purposes of uncertainty propagation, this value could be interpreted as $X \pm X/(2 \cdot 3)$ where the uncertainty value is derived assuming a rectangular (uniform) distribution within the interval 0 to X.

Coding



Certified for trace elements.
Reference/information values for:
BET
TGA
Raman spectra
Particle size
Zeta potential
among others

What is new at NRC: Nanomaterial CRMs

Cellulose Nanocrystal

CNC-1 (powder)



CNCS-1 (suspension)



Certified for trace elements. Reference/information values for BET, TGA, Raman spectra, particle size, Zeta potential, among others

CRMs- New activities

Inorganic CRMs

- ✓ Milk
- ✓ Isotopic
- ✓ matrix CRMs for isotopic abundance
- ✓ High purity metals
- ✓ Salt
- ✓ SeMet natural and labelled

Organic CRMs

- ✓ Cannabis – to support testing for Canada's medical market

