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NIES Certified Reference Material, Tea Leaves

The National Institute for Environmental Studies (NIES) announces the availability of NIES Certified Reference Material No. 7, Tea Leaves.

Trace element analysis of a variety of plant materials has been carried out throughout the world in the fields of agricultural and environmental sciences. In 1980 NIES issued Peppercorn certified reference material, which has elevated levels of Mn, Zn, Co, Ni and Cd compared to other botanical CRMs, has been used in many domestic and overseas laboratories. Following the Peppercorn CRM, NIES has recently undertaken the development of a new type of botanical reference material, Tea Leaves.

The material was prepared from tea leaves (*Yabukita* sp) obtained from Shimizu, Shizuoka Prefecture, Japan. The dried tea leaves were ground, sieved to pass a 80-mesh screen, blended and bottled. The bottles contain about 22 g of material.

Certified values are provided for Al, Ca, Cd, Cu, K, Mg, Mn, Na, Ni, Pb and Zn, while reference values are reported for Ba, Co, Cr, Cs, P, Sb, Sc and Sr. The elemental composition of this reference material is considered typical of Japanese green tea leaves.

Preparation of Material

This reference material was prepared from processed, middle-grade tea leaves "Sencha", which were obtained from a tea garden at Oh-hira, Shimizu, Shizuoka Prefecture, Japan. At the tea garden inorganic pesticides and fungicides have not been used and, therefore, the tea leaves (*Yabukita* sp.) may be considered to contain natural levels of trace metals. About 30 kg of the dried tea leaves were used in this work.

Dry leaves (about 700 g) were ground for about 1 hr in a ball-mill (95% alumina 7 L) which had been pre-cleaned by a previous grinding of tea leaves. The pulverized samples were placed on a set of screens, a 50-mesh (297 μ m) nylon screen (top), a 80-mesh (177 μ m) nylon screen (middle) and a reservoir made of polyvinylchloride (bottom), and then vibrated mechanically for 15 min. The powder having passed through the 80-mesh screen (about 13 kg) was mixed in a V-blender (150 L) for 2 hr. The homogenized powder was then packaged into about 600 acid-washed glass bottles (20 g, each).

Homogeneity Assessment

In order to estimate the homogeneity of the material, the variation of elemental content in several bottles was examined by inductively coupled plasma emission and atomic absorption analyses following acid digestion. Five bottles were randomly selected from the lot of 600 bottles and 5 aliquots (about 250 mg dry weight) were taken from each bottle (total 25 samples).

The homogeneity of the tea leaves reference material was estimated by analysis of variance. For the elements Mg, Ca, Zn, Al, Mn, Cu and Sr, variations due to sample variability were estimated to be less than 1% (as relative standard deviation), indicating that the prepared Tea Leaves satisfies the homogeneity criteria for a reference material. However, between-bottle variation was significant for Fe. The reason for this has not been clarified.

Certified values

The certified values are based on results of determinations by at least two independent analytical techniques. The uncertainties of the certified values were estimated based on consideration of 2 times the standard deviation of the mean of the acceptable values, and of the 95% confidence intervals for the mean of individual methods.

Instruction for Drying

The material should be dried in an air-oven at 85 °C for 4 hr before use. The mean moisture loss will be about 2.4%. For the determination of volatile elements such as Hg and Se, drying should be done samples separate from those for analysis.

Sample Size

A minimum sample weight of 250 mg of the dry material should be used. A homogeneity test varying the sample size from 20 mg to 250 mg showed the best homogeneity for the 250 mg sample.

Storage

The material should be kept tightly closed in its original bottle and stored in a desiccator at room temperature.

Additional Information

This reference material contains siliceous material, which is an integral part of the sample. The certified and reference values are based on analyses performed on the entire sample. Therefore, decomposition procedure should be designed to achieve complete dissolution of the material such as by the use of a mixture of nitric/perchloric/hydrofluoric acids.

Analytical Values for NIES Certified Reference Material No. 7, "Tea Leaves"

Certified Values			
Element	Content*	Element	Content*
Major and Minor Constituents	Wt. Percent	Trace Constituents	$\mu\text{g/g}$
K ^{a, b, c, e}	1.86 ± 0.07	Al ^{a, c, e}	775 ± 20
Ca ^{a, c, e}	0.320 ± 0.012	Mn ^{a, c, e}	700 ± 25
Mg ^{a, c, e}	0.153 ± 0.006	Zn ^{a, c, d, e}	33 ± 3
		Na ^{a, b, c, e}	15.5 ± 1.5
		Cu ^{a, c, d}	7.0 ± 0.3
		Ni ^{a, c, d, e}	6.5 ± 0.3
		Pb ^{a, d}	0.80 ± 0.03
		Cd ^{a, d}	0.030 ± 0.003

Analytical techniques used: ^a atomic absorption spectrometry; ^b flame emission spectrometry; ^c inductively coupled plasma atomic emission spectrometry; ^d isotope dilution mass spectrometry, thermal ionization; ^e neutron activation analysis

Reference Values			
P	0.37 (Wt. Percent)		
Ba	5.7 $\mu\text{g/g}$	Cs	0.022 $\mu\text{g/g}$
Sr	3.7	Sb	0.014
Cr	0.15	Sc	0.011
Co	0.12		

* On a dry weight basis.