



**WAGENINGEN EVALUATING PROGRAMS
FOR ANALYTICAL LABORATORIES**

Certificate of Analysis



International Plant-Analytical Exchange

REFERENCE MATERIAL

IPE sample 241



General Information

In this report an overview is given of analytical data for this sample collected in our proficiency testing program. The consensus values are calculated using a robust statistical model. With this NDA model mean and standard deviation are calculated using all reported data when at least 8 results are left after removal of reported 'lower than' (<) and 0 (= zero) values. No outliers are removed.

This report is divided into three sections: Consensus Values, Indicative Values and Values for Information. The division is made on the reliability of the data. Consensus Values are based on at least 16 results while the coefficient of variation is smaller than 25 %. Indicative Values are based on at least 8 and less than 16 results or a coefficient of variation between 25 % and 50 %. Other values, based on more than 2 and less than 8 results or a coefficient of variation higher than 50 %, are given for information only.

In the sections with Consensus Values and Indicative Values the following parameters are given: mean, standard deviation, coefficient of variation, number of results, median and MAD (Median of Absolute Deviation) and the uncertainty in the consensus values. The confidence limits (at 95 % probability) are calculated for these determinands.

In the section with Information Values the following parameters are given: median, MAD and number of results. For determinands which have at least 5 results reported as smaller than (<) the median of these 'smaller than results' is calculated. In some cases this median of '<' values is much smaller than median and mean of the indicative values. This may be caused by a too optimistic (too low) value for the detection limit reported by a (small) majority of participating laboratories who report '<' -values.

All values, expressed on a weight basis (kg or %), are reported in oven dry (105 °C) material. Moisture is reported in the material as received.

Sample information

WEPAL reference materials are from natural sources only. There is no spiking, mixing or other alterations of the samples. For sample preparation the IPE samples are dried at 70 °C and milled to pass a 0.5 mm sieve.

This IPE sample 241 of Cacao leaf / Theobroma cacao from Ivory Coast is prepared for the WEPAL proficiency programs. The sample is used in 2 periods (or rounds). The results on which the values in this report are based were taken from the periods given in the following table.

Year	Round	Number
2023	2	2
2018	3	2



Consensus Values IPE 241



Method: Inorganic Chemical Composition

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits		
B	mg/kg	56.0	5.57	9.9	167	55.9	3.87	0.54	55.2	-	56.9
Ba	mg/kg	111	11.7	10.5	21	110	8.0	3.2	106	-	117
Ca	g/kg	18.5	1.27	6.8	204	18.6	0.88	0.11	18.36	-	18.71
Cd	µg/kg	221	31.4	14.2	60	223	22.3	5.1	212	-	229
Co	µg/kg	6950	654	9.4	56	6960	455	109	6775	-	7126
Cr	µg/kg	516	127.0	24.6	45	522	92.8	23.7	478	-	554
Cu	mg/kg	23.8	2.69	11.3	202	23.7	1.85	0.24	23.41	-	24.15
Fe	mg/kg	163	17.1	10.5	195	161	11.8	1.5	160.2	-	165.0
Hg	µg/kg	17.1	2.87	16.8	29	17.4	2.03	0.67	16.0	-	18.2
K	g/kg	16.1	1.01	6.3	216	16.1	0.70	0.09	15.98	-	16.25
Mg	g/kg	6.89	0.481	7.0	205	6.86	0.340	0.042	6.83	-	6.96
Mn	mg/kg	500	36.9	7.4	197	500	25.5	3.3	494	-	505
Mo	µg/kg	347	78.3	22.6	53	355	55.0	13.5	325	-	369
N - Kjeldahl (as N)	g/kg	20.5	0.74	3.6	132	20.5	0.51	0.08	20.41	-	20.66
Na	mg/kg	146	23.4	16.0	116	146	16.0	2.7	142	-	150
Ni	µg/kg	16600	2010	12.2	47	16400	1410	370	15970	-	17150
P (as P)	g/kg	1.77	0.100	5.6	210	1.78	0.068	0.009	1.76	-	1.78
Pb	µg/kg	286	67.1	23.5	48	294	50.3	12.1	267	-	305
S (as S)	g/kg	2.52	0.212	8.4	123	2.52	0.150	0.024	2.48	-	2.55
Se	µg/kg	315	52.7	16.7	29	308	38.0	12.2	295	-	335
Sr	mg/kg	186	14.0	7.5	16	187	9.5	4.4	179	-	194
V	µg/kg	296	51.5	17.4	20	293	36.5	14.4	272	-	320
Zn	mg/kg	63.5	5.21	8.2	198	63.5	3.57	0.46	62.8	-	64.3

Method: Real totals

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits		
Al	mg/kg	193	38.3	19.9	18	193	26.6	11.3	174	-	212
C - elementary	g/kg	453	14.4	3.2	62	453	9.7	2.3	449.5	-	456.8
N - elementary	g/kg	21.5	0.86	4.0	93	21.6	0.59	0.11	21.36	-	21.71

Method: Acid extractable (So-called totals)

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits		
Al	mg/kg	149	26.2	17.5	47	150	17.7	4.8	142	-	157



Consensus Values IPE 241

Method: Nutritional values

Element

Total ash

Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits		
g/kg	125	5.8	4.6	30	125	4.1	1.3	122.9	-	127.2



Indicative Values IPE 241

Method: Inorganic Chemical Composition

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits		
As	µg/kg	49.0	13.13	26.8	32	53.2	9.45	2.90	44.3	-	53.7
Cl (as Cl)	g/kg	0.577	0.2286	39.6	33	0.600	0.1700	0.0497	0.496	-	0.658
Li	µg/kg	102	16.2	15.8	8	105	10.5	7.1	89.0	-	115
N - NO ₃ (as N)	mg/kg	122	14.6	12.0	11	120	10.0	5.5	112	-	131
Sb	µg/kg	20.0	5.27	26.3	9	20.8	3.75	2.20	16.0	-	24.0
Ti	mg/kg	7.15	1.273	17.8	12	7.33	0.935	0.459	6.35	-	7.96

Method: Other determinations

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits		
delta 13C	‰ V-PDB	-31.2	0.11	0.4	9	-31.2	0.07	0.05	-31.24	-	-31.07
delta 15N	‰ Air	6.32	0.155	2.4	9	6.27	0.100	0.064	6.20	-	6.44

Method: Nutritional values

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits		
Crude fibre	g/kg	415	20.8	5.0	15	418	14.1	6.7	404	-	427



Informative Values IPE 241



Method: Inorganic Chemical Composition

Element	Unit	Median	MAD	N
Ag	µg/kg	3.92	1.770	3
Be	µg/kg	24.4	2.90	7
I	µg/kg	501	235.0	5
Rb	µg/kg	14800	950	7
Sn	µg/kg	66.6	46.60	5

Method: Real totals

Element	Unit	Median	MAD	N
Si	mg/kg	11100	4040	5

Method: Acid extractable (So-called totals)

Element	Unit	Median	MAD	N
Si	mg/kg	2040	1346	7

Method: Nutritional values

Element	Unit	Median	MAD	N
ADF-ash-free	g/kg	534	29.0	7
NDF-ash-free	g/kg	618	43.0	6
Total fat	g/kg	21.4	9.60	13