



**WAGENINGEN EVALUATING PROGRAMS  
FOR ANALYTICAL LABORATORIES**

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**Certificate of Analysis**



**International Plant-Analytical Exchange**

**REFERENCE MATERIAL**

**IPE sample 236**

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## 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 236 of Barley (straw) / *Hordeum vulgare* from Austria is prepared for the WEPAL proficiency programs. The sample is used in 3 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	4	3
2021	2	4
2018	2	3



## Consensus Values IPE 236



### Method: Inorganic Chemical Composition

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits	
Cu	mg/kg	4.35	0.504	11.6	270	4.33	0.342	0.038	4.29	- 4.41
Fe	mg/kg	432	48.0	11.1	264	430	33.3	3.7	426	- 438
Mn	mg/kg	21.0	1.59	7.6	263	20.9	1.10	0.12	20.79	- 21.17
Zn	mg/kg	19.9	1.74	8.8	273	19.9	1.20	0.13	19.69	- 20.10
As	µg/kg	327	32.4	9.9	57	329	22.0	5.4	319	- 336
Cd	µg/kg	29.8	3.04	10.2	66	30.0	2.11	0.47	29.0	- 30.5
Co	µg/kg	153	12.7	8.3	60	151	8.5	2.1	149.9	- 156.5
Cr	µg/kg	1360	252	18.5	65	1390	177	39	1296	- 1421
Hg	µg/kg	5.15	0.882	17.1	27	5.18	0.617	0.212	4.80	- 5.50
Mo	µg/kg	338	49.9	14.8	74	339	35.8	7.3	327	- 350
Ni	µg/kg	504	74.1	14.7	49	504	52.0	13.2	483	- 525
Pb	µg/kg	454	56.4	12.4	75	460	39.8	8.1	441	- 467
Ba	mg/kg	13.0	1.99	15.3	25	13.2	1.40	0.50	12.2	- 13.9
Sn	µg/kg	53.0	7.49	14.1	16	54.2	5.67	2.34	49.1	- 57.0
Sr	mg/kg	13.8	0.83	6.0	23	13.9	0.56	0.22	13.44	- 14.16
Ca	g/kg	4.68	0.324	6.9	287	4.67	0.225	0.024	4.64	- 4.72
Cl (as Cl)	g/kg	8.11	0.569	7.0	52	8.05	0.400	0.099	7.96	- 8.27
K	g/kg	16.6	0.98	5.9	300	16.5	0.66	0.07	16.53	- 16.75
Mg	g/kg	1.64	0.105	6.4	287	1.63	0.072	0.008	1.62	- 1.65
N - Kjeldahl (as N)	g/kg	12.4	0.59	4.7	176	12.4	0.40	0.06	12.30	- 12.47
Na	mg/kg	302	36.7	12.1	167	304	25.7	3.5	297	- 308
P (as P)	g/kg	2.13	0.134	6.3	299	2.13	0.092	0.010	2.11	- 2.14
S (as S)	g/kg	1.85	0.124	6.7	170	1.85	0.085	0.012	1.83	- 1.87

### Method: Real totals

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits	
C - elementary	g/kg	439	12.7	2.9	104	438	8.6	1.6	436.7	- 441.6
N - elementary	g/kg	12.9	0.52	4.1	148	12.8	0.35	0.05	12.79	- 12.96

### Method: Acid extractable (So-called totals)

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits	
Al	mg/kg	451	107.1	23.7	65	450	74.0	16.6	425	- 478

### Method: Other determinations

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits	
delta 13C	‰ V-PDB	-28.6	0.21	0.8	27	-28.6	0.15	0.05	-28.69	- -28.52
delta 15N	‰ Air	1230	29	2.4	26	1230	20	7	1215	- 1238



### Consensus Values IPE 236

Method: Nutritional values

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits		
Crude fibre	g/kg	204	9.4	4.6	18	206	6.1	2.8	199	-	208
Total ash	g/kg	72.9	3.70	5.1	42	72.5	2.58	0.71	71.7	-	74.0



## Indicative Values IPE 236



### Method: Inorganic Chemical Composition

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits		
B	mg/kg	3.53	1.076	30.5	190	3.65	0.763	0.098	3.38	-	3.69
I	µg/kg	86.7	14.32	16.5	9	90.0	10.00	5.97	75.9	-	97.4
Li	µg/kg	517	55.7	10.8	14	514	36.9	18.6	485	-	549
Se	µg/kg	63.4	21.32	33.6	35	65.8	15.81	4.50	56.1	-	70.7
Sb	µg/kg	17.6	6.00	34.1	16	17.8	4.25	1.88	14.4	-	20.8
Ti	mg/kg	10.00	3.682	36.8	18	10.69	2.555	1.085	8.17	-	11.8
V	µg/kg	906	227.8	25.1	22	901	157.5	60.7	805	-	1007
Be	µg/kg	21.6	2.30	10.6	10	21.6	1.60	0.91	19.9	-	23.2
Rb	µg/kg	2920	496	17.0	11	3100	307	187	2594	-	3252
N - NO3 (as N)	mg/kg	17.6	8.66	49.1	13	19.2	6.28	3.00	12.4	-	22.8
SO4 (as SO4)	g/kg	2.40	0.560	23.4	8	2.57	0.395	0.248	1.94	-	2.86

### Method: Real totals

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits		
Al	mg/kg	670	240.4	35.9	30	681	166.3	54.9	581	-	760

### Method: Nutritional values

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits		
ADF-ash-free	g/kg	230	10.7	4.7	10	231	7.0	4.2	222	-	237
NDF-ash-free	g/kg	450	15.0	3.3	10	448	10.5	5.9	440	-	461
Total fat	g/kg	22.8	6.24	27.4	17	23.1	4.10	1.89	19.6	-	26.0



## Informative Values IPE 236



### Method: Inorganic Chemical Composition

Element	Unit	Median	MAD	N
F	mg/kg	9.36	0.140	3
Bi	µg/kg	6.50	1.585	4
Ag	µg/kg	3.23	0.890	5
Cs	µg/kg	80.9	0.70	3
N - NH4 (as N)	mg/kg	564	439.6	4

### Method: Real totals

Element	Unit	Median	MAD	N
Si	mg/kg	8600	654	7

### Method: Acid extractable (So-called totals)

Element	Unit	Median	MAD	N
Si	mg/kg	6550	3819	11

### Method: Nutritional values

Element	Unit	Median	MAD	N
Total monosaccharides	g/kg	39.0	2.00	3