A Streamlined Procedure for the Determination of Trace Elements in Foods

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Considerable analytical challenges were imposed on food chemists when Congress passed the Nutrition Labeling and Education Act of 1990 (NLEA). When this law was ratified, labeling of fourteen food nutrients became mandatory, and thirty-four others voluntary. Many Association of Official Analytical Chemists (AOAC) validated methods for foods are matrix or analyte specific. Developing rugged, generic methodology for all foods became a high priority. Streamlined sample preparation became essential. To aid this endeavor, foods were categorized by protein, fat, and carbohydrate content. This work targets all the NLEA trace mineral nutrients in all food matrices. Much of the analytical challenge to these determinations results from widely divergent levels of the analytes present and from high levels of dissolved salts and organics contributing to matrix effects and spectral interferences.

A streamlined procedure suitable for all food matrices will be presented. The procedure involves a microwave digestion followed by dual view Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES) determination. This streamlined approach allows one procedure to be used for all food analyses. Data quality objectives are rigorous and results are validated through the analysis of Standard Reference Materials (SRM) and determining laboratory fortified sample (spike) recoveries. Analytical figures of merit also will be presented.

Examples of results in µg/g are presented below. Standard deviations presented result from 3 replicate determinations of each SAM.

NIST SAM 1750 Spinach (Sector 7)

Analyte	Mean	Std. dev	Certified Value
A1308.215	697.8	0.2	870 ± 50
A1396.152	635.3	0.1	870 ± 50
Ba 233.527	14.67	0.02	
Ca 315.887	13359	3	13500 ± 300
Ca 317.933	13824	6	13500 ± 300
Cu 324.754	12.96	0.02	12.2±2
Fe 238.204	549.0	0.05	550 ± 20
K 766.491	39097	< 0.01	
Mg 285.213	8962	3	35600 ± 300
Mn 257.610	175	0.01	165 ± 6
Zn 202.548	54.31	0.07	50 ± 2
Zn 206.200	57.46	0.07	50 ± 2
Zn 213.856	55.60	0.07	50 ± 2

NIST SAM 1549 Milk Powder (Sector 7)

Analyte	Mean	Std. dev.	Certified
Ca 317	12900	451	13000 ± 500
Mg 279.553	1210	46	1200 ± 300
Mn 257	0.44	0.04	0.26 ± 0.06
Na 589	5076	126	4970 ± 100
Zn 213	46.5	1.2	46.1 ± 2.2

3. **NIST** SAM 1577a Bovine Liver (Sector 9)

Analyte	Mean	Std. Dev	Certified
A1308.215	5.3	2	2*
A1396.152	5.8	1	2*
Ca 315.887	112	9	120 ± 7
Ca 317.933	111	10	120 ± 7
Cu 324.754	178	21	158 ± 7
Fe 238.204	240	25	194 ± 20
K 766.491	8395	544	9960 ± 70
Mg 279.553	568	49	600 ± 1
Mg 285.213	552	31	600 ± 15
Mn 257.610	10	1	9.9 ±0.08
Na 589.592	2050	339	2430 ± 130
Zn 202.548	127	15	123 ± 8
Zn 206.200	126	15	123 ± 8

Values were given for information only and were not certified

4. NIST SAM 1548 Total Diet (Sector 4)

Analyte	Mean	**Std. Dev**	**Certified**
A1308.215	76.3	5.3	
A1396.152	74.6	4.7	**66.7** :t: **0.03**
Ca 315.887	1908	18	**1960** :t: 5
Ca 317.933	1907	11	**1970:t:6**
Cu 324.754	2.34	<0.1	
Fe 238.204	39.1	0.3	
K 766.491	5940	92	**6800** :t: **20**
Mg 279.553	627	57	
Mg 285.213	563.1	6.8	**589** :t: 2
Mn 257.610	6.4	0.3	
Zn 202.548	29.8	1.4	**24.05** :t: **0.05**
Zn 206.200	29.6	1.3	**24.05** :t: **0.05**
Zn 213.856	26.8	0.9	**24.05** :t: **0.05**