Fapas® – Cosmetics Chemistry Proficiency Test Report CC0008

Metallic Contaminants in Facial Cream

August-September 2025

PARTICIPANT LABORATORY NUMBER

Participants can log in to Fapas® SecureWeb at any time to obtain their laboratory number for this proficiency test.

Laboratory numbers are displayed in SecureWeb next to the download link for this report.

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QUALITY SYSTEMS

This proficiency test has been conducted according to the principles of ISO/IEC 17043:2023 [3] but is not within the scope of Fapas® accreditation.

This report is the output of a Management System that is certified by LRQA to ISO 9001:2015 [4, 5].

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SUMMARY

1. The test materials for Fapas® – Cosmetics Chemistry proficiency test CC0008 were dispatched in August 2025. Each participant received a facial cream test material to be analysed for Arsenic (total), Antimony, Cadmium, Chromium, Cobalt, Lead, Mercury (total) and Nickel.
2. An assigned value (x_a) was determined for each analyte and in conjunction with the standard deviation for proficiency (σ_p) was used to calculate a z-score for each result.
3. Results for this proficiency test are summarised as follows:

analyte	assigned value, x_a mg/kg	number of scores, $\|z\| \leq 2$	total number of scores	% $\|z\| \leq 2$
Arsenic (total)	5.30	11	12	92
Antimony	5.50	7	7	100
Cadmium	5.98	12	12	100
Chromium	6.14	8	8	100
Cobalt	6.76	8	8	100
Lead	7.20	11	12	92
Mercury (total)	2.67	10	11	91
Nickel	5.44	10	10	100

CONTENTS

1. INTRODUCTION

1.1. Proficiency Testing

Proficiency testing aims to provide an independent assessment of the competence of participating laboratories. Together with the use of validated methods, proficiency testing is an essential element of laboratory quality assurance.

Further details of the Fapas® – Food Chemistry proficiency testing scheme are available in our protocols [6, 7].

2. TEST MATERIAL

2.1. Preparation

The test materials were prepared from commercially available facial cream.

All analytes were spiked into the test material.

Samples were stored at ambient temperature until dispatch.

2.2. Homogeneity Testing and Stability

To test for homogeneity, randomly selected test materials were analysed in duplicate. Testing was sub-contracted to a laboratory meeting the quality requirements of the scheme.

These data showed sufficient homogeneity and were not included in the subsequent calculation of the assigned values.

Fapas® proficiency test materials are prepared such that they are known to be sufficiently stable for the duration of the test, inclusive of transportation [6]. No further specific stability testing was required for this proficiency test.

2.3. Dispatch

The start date was 01 August 2025. Test materials were sent to 15 participants.

3. RESULTS

The instructions for reporting results were as follows:

> Treat the test material as if it was a sample for routine analysis. You may use any method of analysis you wish but PLEASE NOTE:
>
> - You are advised to keep the material at ambient temperature until analysis.
> - Report the result in the material in the form it is received (no further correction for wet weight or dry weight or reconstitution).
> - Please mix the entire contents to ensure the sample is homogeneous before analysis.

Determine the level of analyte(s) present in the test material as follows:

analyte	units	comment
Arsenic (total)	mg/kg	as received
Antimony	mg/kg	as received
Cadmium	mg/kg	as received
Chromium	mg/kg	as received
Cobalt	mg/kg	as received
Lead	mg/kg	as received
Mercury (total)	mg/kg	as received
Nickel	mg/kg	as received

PLEASE NOTE: It is important that you report the results in this way so that we can include as many results as possible in the statistical analysis.

Results were submitted by 15 participants (100%) before the closing date for this test, 11 September 2025.

Each participant was given a laboratory number, assigned in order of receipt of results. The reported analyte concentrations are given in Tables 1-2.

Participants' comments are given in Table 3.

The analytical methods used by each participant are summarised in APPENDIX I.

4. STATISTICAL EVALUATION OF RESULTS

The results submitted by participants were statistically analysed in order to provide an assigned value for each analyte. The assigned values were then used in combination with the standard deviation for proficiency, σ_p, to calculate a z-score [8] for each result. The procedure is detailed in the relevant protocols [6, 7].

Further background on the procedure followed can be found in the IUPAC International Harmonised Protocol for the Proficiency Testing of Analytical Chemistry Laboratories [9].

4.1. Calculation of the Assigned Value, x_a

The assigned value, x_a, for each analyte was derived from the consensus of the results submitted by participants.

The procedure used to derive this consensus involved:

i) exclusion, if present, of any non numerical results i.e. qualitative or semi-quantitative results,

ii) exclusion, if present, of any results that were approximately 10, 100 or 1000 × greater or smaller than the majority of submitted results (as these were considered to be reporting errors).

For all analytes, the median was chosen as the assigned value because of the low number of datapoints.

The assigned values for all analytes are shown in Table 4.

4.2. Standard Deviation for Proficiency, σ_p

The standard deviation for proficiency, σ_p, was set at a value that reflects best practice for the analyses in question.

For all analytes, σ_p was derived from the appropriate form of the Horwitz equation [10].

The values for σ_p used to calculate z-scores from the reported results of this test are given in Table 4.

4.3. Individual z-Scores

Participants' z-scores were calculated as:

$$z = \frac{(x - x_a)}{\sigma_p}$$

where x = the participant's reported result,
x_a = the assigned value, see Table 4,
and σ_p = the standard deviation for proficiency, see Table 4.

Participants' z-scores for all analytes are given in Tables 1-2 and shown as histograms in Figures 1–8. It is possible for the z-scores published in this report to differ slightly from the z-score that can be calculated using the formula given above. These differences arise from the necessary rounding of the actual assigned values and standard deviations for proficiency prior to their publication in Table 4.

The number and percentage of z-scores in the range $-2 \leq z \leq 2$ for all analytes are given in Table 5.

5. INTERPRETATION OF SCORES

In normal circumstances, over time, about 95% of z-scores will lie in the range $-2 \leq z \leq 2$. Occasional scores in the range $2 < |z| < 3$ are to be expected, at a rate of 1 in 20. Whether or not such scores are of importance can only be decided by considering them in the context of the other scores obtained by that laboratory.

Scores where $|z| > 3$ are to be expected at a rate of about 1 in 300. Given this rarity, such z-scores very strongly indicate that the result is not fit-for-purpose and almost certainly requires investigation.

The consideration of a set or sequence of z-scores over time provides more useful information than a single z-score. Examples of suitable methods of comparison are provided in the IUPAC International Harmonised Protocol for the Proficiency Testing of Analytical Chemistry Laboratories [9].

6. REFERENCES

1 Adobe Approved Trust List, https://helpx.adobe.com/acrobat/kb/approved-trust-list2.html#Whatisit accessed 28/01/2025.

2 GlobalSign AATL Document Signing FAQs, https://support.globalsign.com/aatl-document/aatl-document-signing-faqs accessed 28/01/2025.

3 ISO/IEC 17043:2023, Conformity assessment – General requirements for the competence of proficiency testing providers.

4 Fera science Ltd, Standards & Accreditations, https://www.fera.co.uk/about-us/standards-and-accreditation accessed 28/01/2025.

5 Lloyd's Register, Learn about ISO 9001 Quality Management Systems (QMS), https://www.lrqa.com/en-gb/iso-9001/?epslanguage=en-GB#accordion-whatarethebenefitsofiso9001certification accessed 28/01/2025.

6 Fapas®, 2025, Protocol for Proficiency Testing Schemes, Version 10, January 2025, Part 1 – Common Principles.

7 Fapas®, 2023, Protocol for Proficiency Testing Schemes, Version 6, January 2023, Part 2 – Fapas® Food Chemistry scheme (FAPAS).

8 AMC Tech Brief No. 74, z-Scores and other scores in chemical proficiency testing – their meanings, and some common misconceptions, *Anal. Methods*, 2016, **8**, 5553.

9 Thompson, M., Ellison, S.L.R. and Wood, R., 2006, The International Harmonised Protocol for the Proficiency Testing of Analytical Chemistry Laboratories, *Pure Appl. Chem.*, **78**, No. 1, 145–196.

10 Thompson, M., 2000, Recent trends in inter-laboratory precision at ppb and sub-ppb concentrations in relation to fitness for purpose criteria in proficiency testing, *Analyst*, **125**, 385-386.

Table 1: Results and z-Scores for Arsenic (total), Antimony, Cadmium and Chromium

laboratory number	analyte							
	Arsenic (total) assigned value: 5.30 mg/kg		Antimony assigned value: 5.50 mg/kg		Cadmium assigned value: 5.98 mg/kg		Chromium assigned value: 6.14 mg/kg	
	result	z-score	result	z-score	result	z-score	result	z-score
001	3.436	**-2.8**	5.754	0.4	6.038	0.1	5.492	-0.9
002	5.35	0.1	5.54	0.1	5.99	0.0	6.73	0.8
003	5.73	0.7			6.32	0.5	6.22	0.1
004								
005	5.3	0.0	5.5	0.0	6.1	0.2	6.1	-0.1
006					6.002	0.0		
007	4.294	-1.5	5.256	-0.4	5.690	-0.4	6.183	0.1
008	4.15	-1.7			5.97	0.0		
009								
010	5.43	0.2						
011	5.290	0.0			5.849	-0.2	6.224	0.1
012	5.33	0.1	5.33	-0.2	5.71	-0.4	5.74	-0.5
013	4.71	-0.9	5.18	-0.5	5.50	-0.7	5.87	-0.4
014	5.43	0.2	5.54	0.1	5.65	-0.5		
015	5.21	-0.1			6.01	0.0		

z-scores outside |z| >2 are shown in **bold,** see Section 5

Table 2: Results and z-Scores for Cobalt, Lead, Mercury (total) and Nickel

laboratory number	analyte							
	Cobalt assigned value: 6.76 mg/kg		Lead assigned value: 7.20 mg/kg		Mercury (total) assigned value: 2.67 mg/kg		Nickel assigned value: 5.44 mg/kg	
	result	z-score	result	z-score	result	z-score	result	z-score
001	6.879	0.1	7.794	0.7	2.669	0.0	5.382	-0.1
002	7.16	0.5	7.22	0.0	2.67	0.0	5.77	0.5
003	7.05	0.4	7.92	0.8	2.90	0.6	5.72	0.4
004					2.89	0.6		
005	6.7	-0.1	7.3	0.1	2.8	0.4	5.5	0.1
006								
007	6.520	-0.3	6.631	-0.7			5.141	-0.4
008			4.91	**-2.7**	1.73	**-2.5**	5.12	-0.5
009							6.35	1.3
010			7.56	0.4				
011	6.578	-0.2	7.172	0.0	2.389	-0.8	5.555	0.2
012	6.45	-0.4	6.93	-0.3	2.70	0.1	5.38	-0.1
013	6.82	0.1	6.75	-0.5	2.26	-1.1	4.97	-0.7
014			6.83	-0.4	2.41	-0.7		
015			7.25	0.1	2.60	-0.2		

z-scores outside |z| >2 are shown in **bold,** see Section 5

Table 3: Participants' Comments

laboratory number	comments
013	ISO TR 17276

comments are as submitted by participants but some may have been edited to maintain participant anonymity

Table 4: Assigned Values and Standard Deviations for Proficiency

analyte	data points, *n*	assigned value, x_a mg/kg	uncertainty, *u*	standard deviation for proficiency, σ_p	
Arsenic (total)	12	5.30	0.06	Horwitz [10]	0.659
Antimony	7	5.50	0.10	Horwitz [10]	0.681
Cadmium	12	5.98	0.05	Horwitz [10]	0.731
Chromium	8	6.14	0.09	Horwitz [10]	0.748
Cobalt	8	6.76	0.11	Horwitz [10]	0.811
Lead	12	7.20	0.16	Horwitz [10]	0.855
Mercury (total)	11	2.67	0.10	Horwitz [10]	0.368
Nickel	10	5.44	0.14	Horwitz [10]	0.675

Table 5: Number and Percentage of z-Scores where $|z| \leq 2$

analyte	number of scores where $\|z\| \leq 2$	total number of scores	% $\|z\| \leq 2$
Arsenic (total)	11	12	92
Antimony	7	7	100
Cadmium	12	12	100
Chromium	8	8	100
Cobalt	8	8	100
Lead	11	12	92
Mercury (total)	10	11	91
Nickel	10	10	100

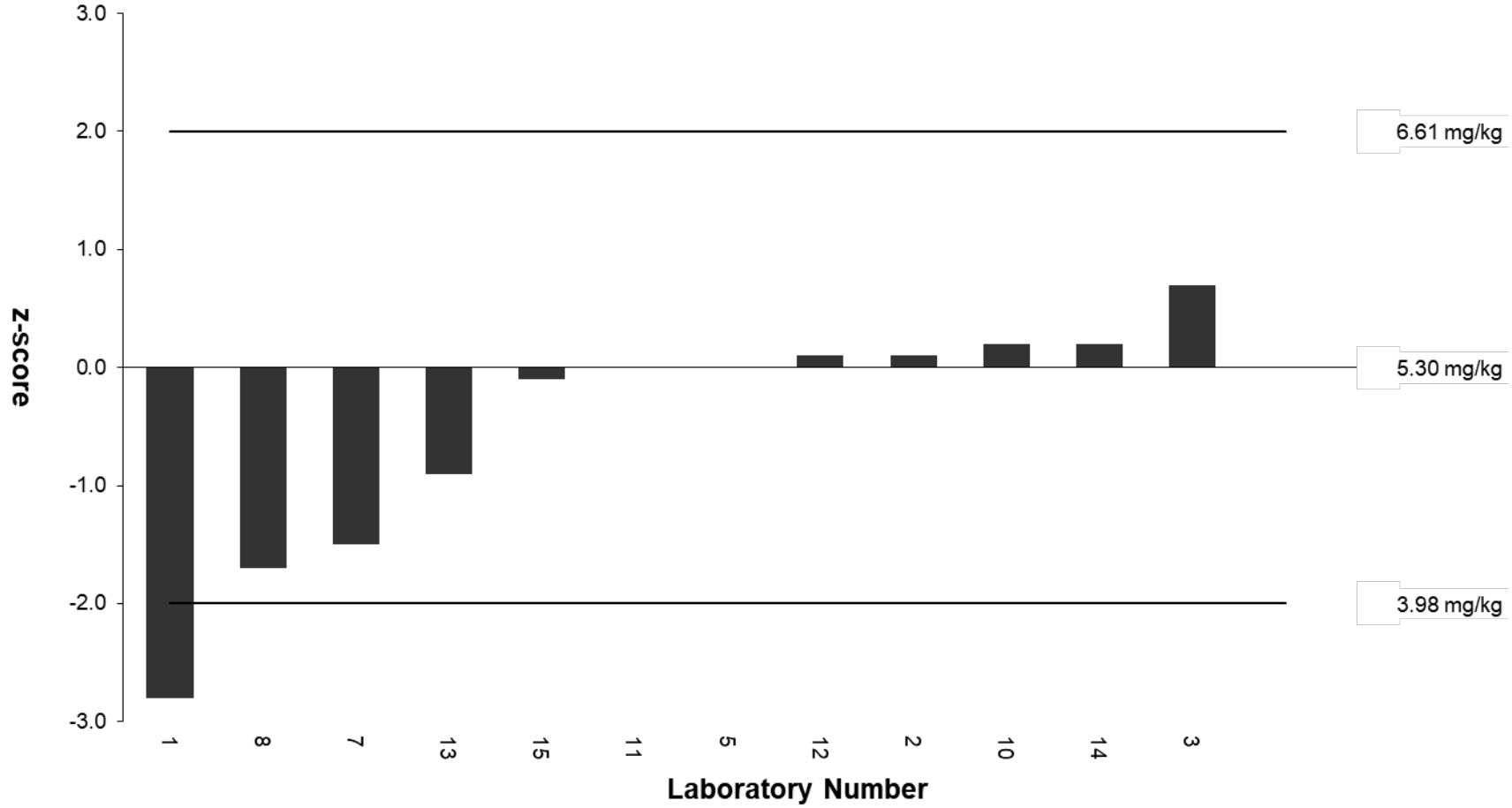

Figure 1: z-Scores for Arsenic (total)

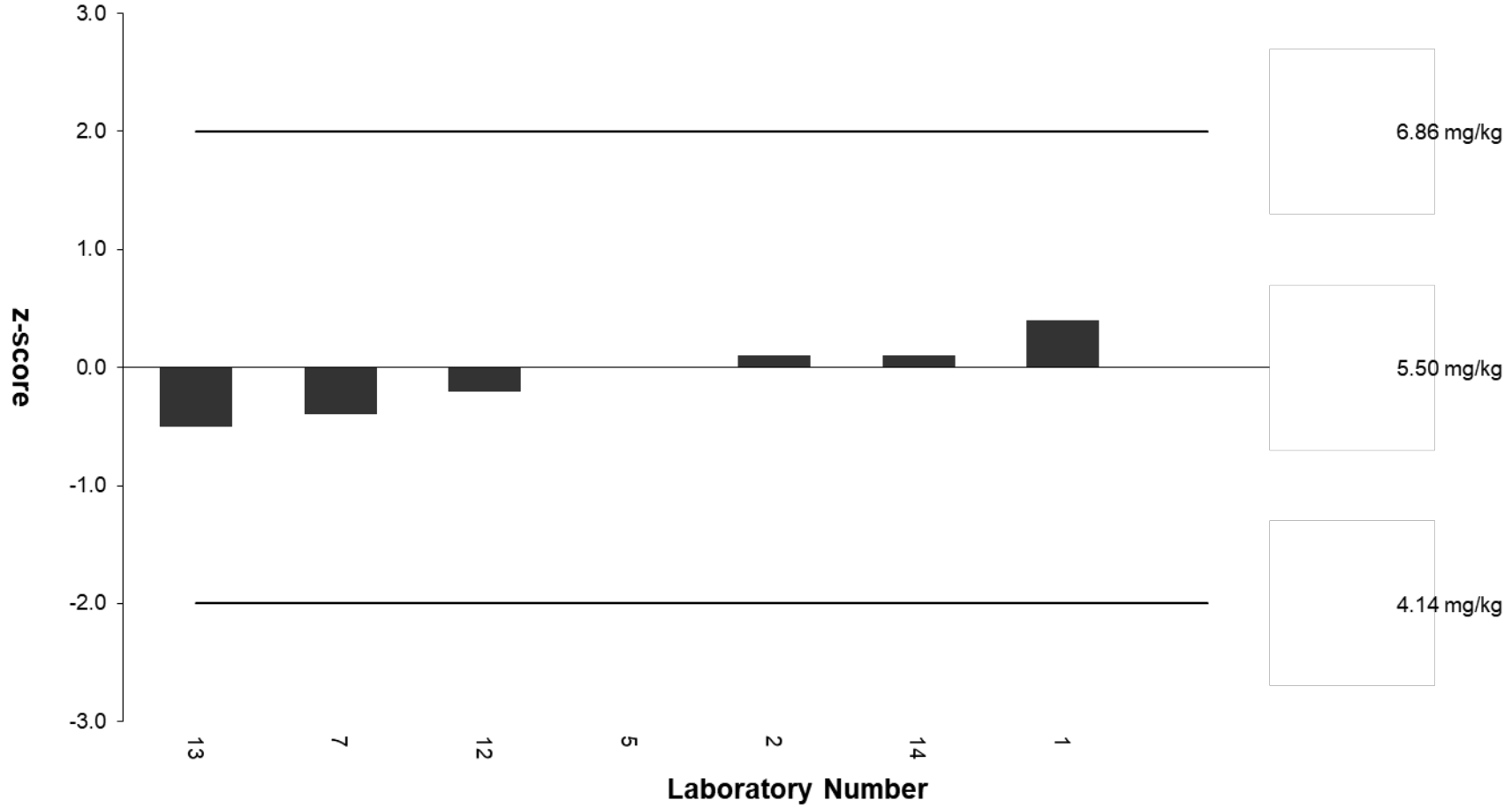

Figure 2: z-Scores for Antimony

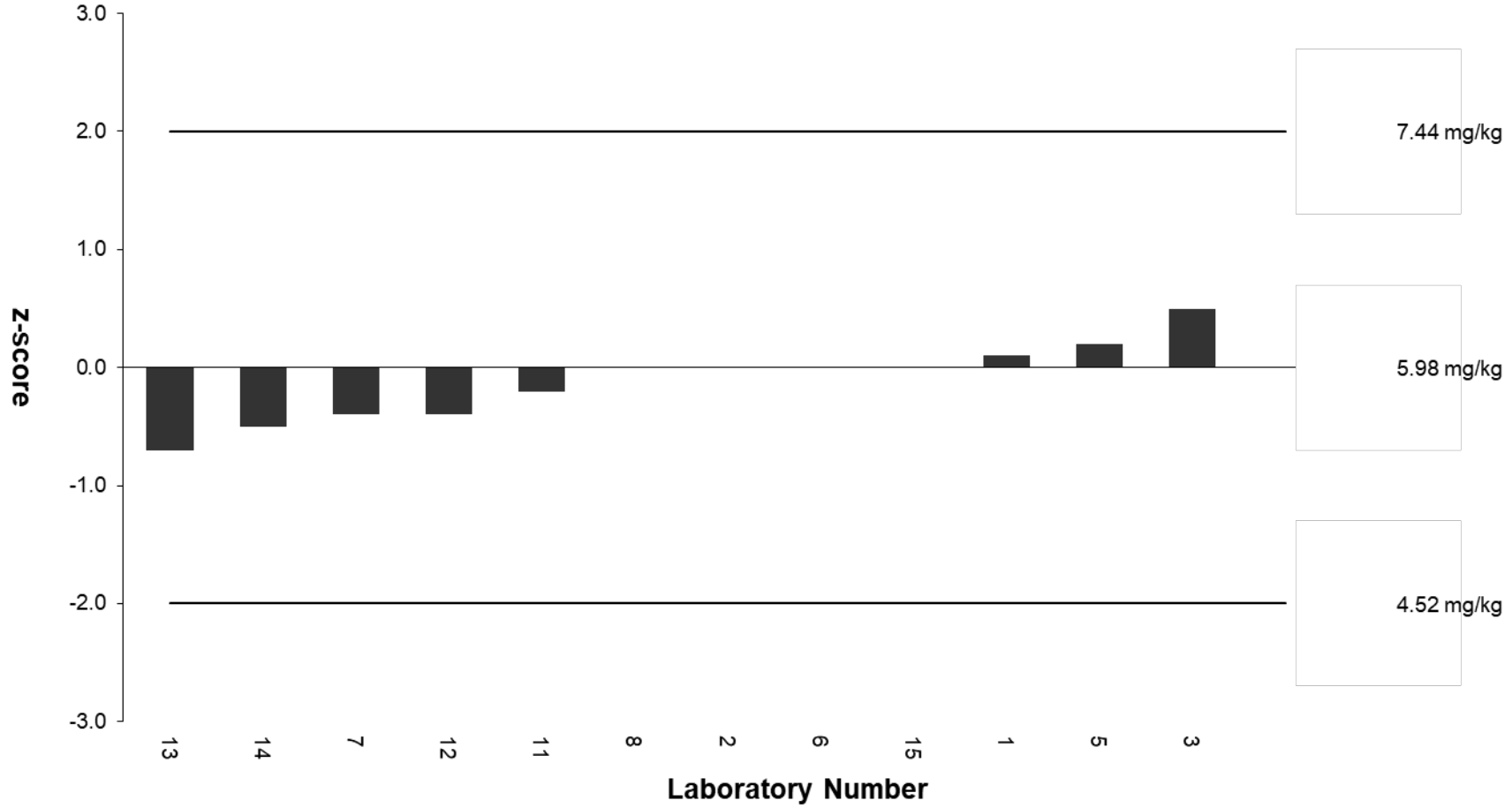

Figure 3: z-Scores for Cadmium

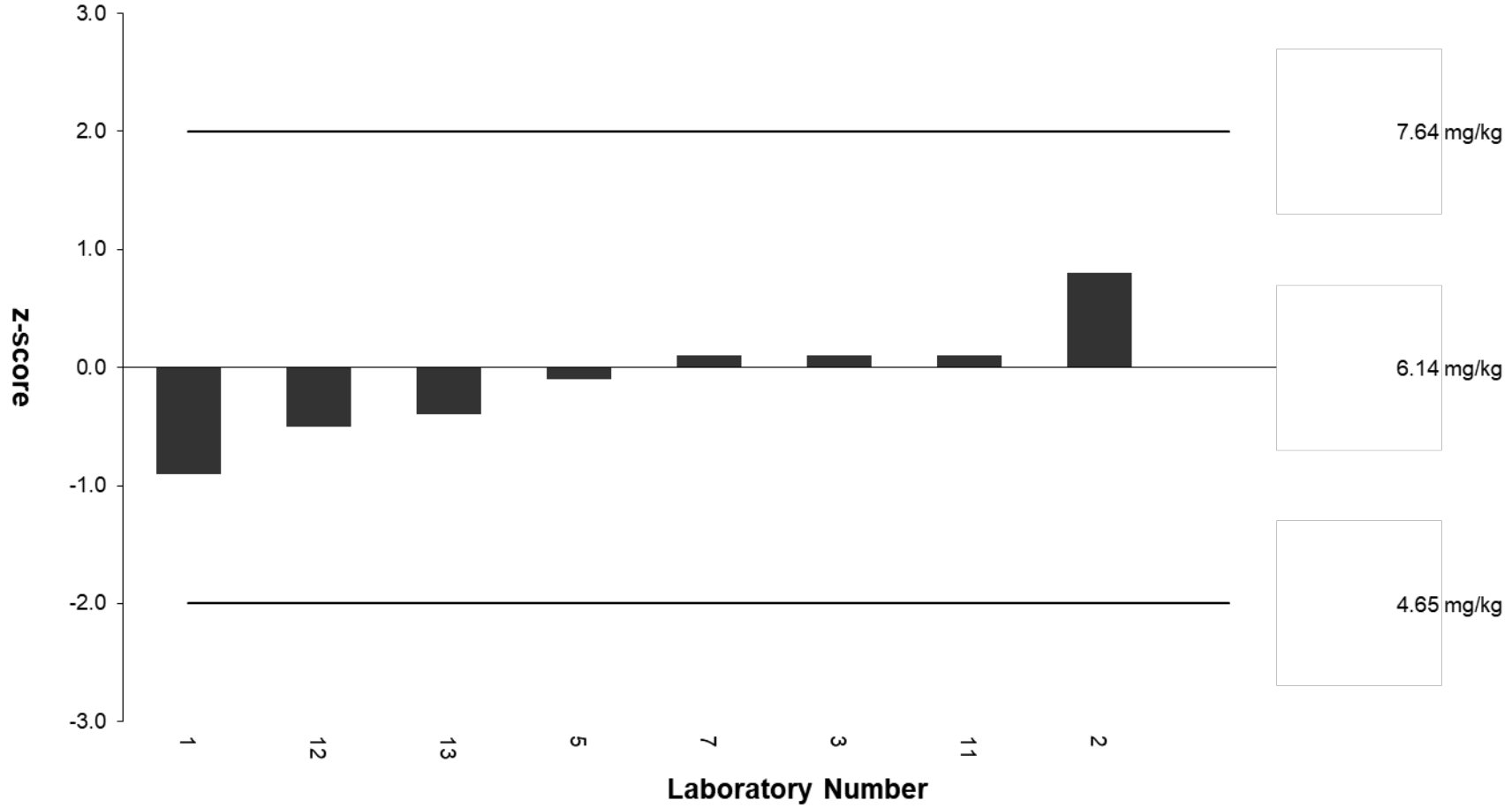

Figure 4: z-Scores for Chromium

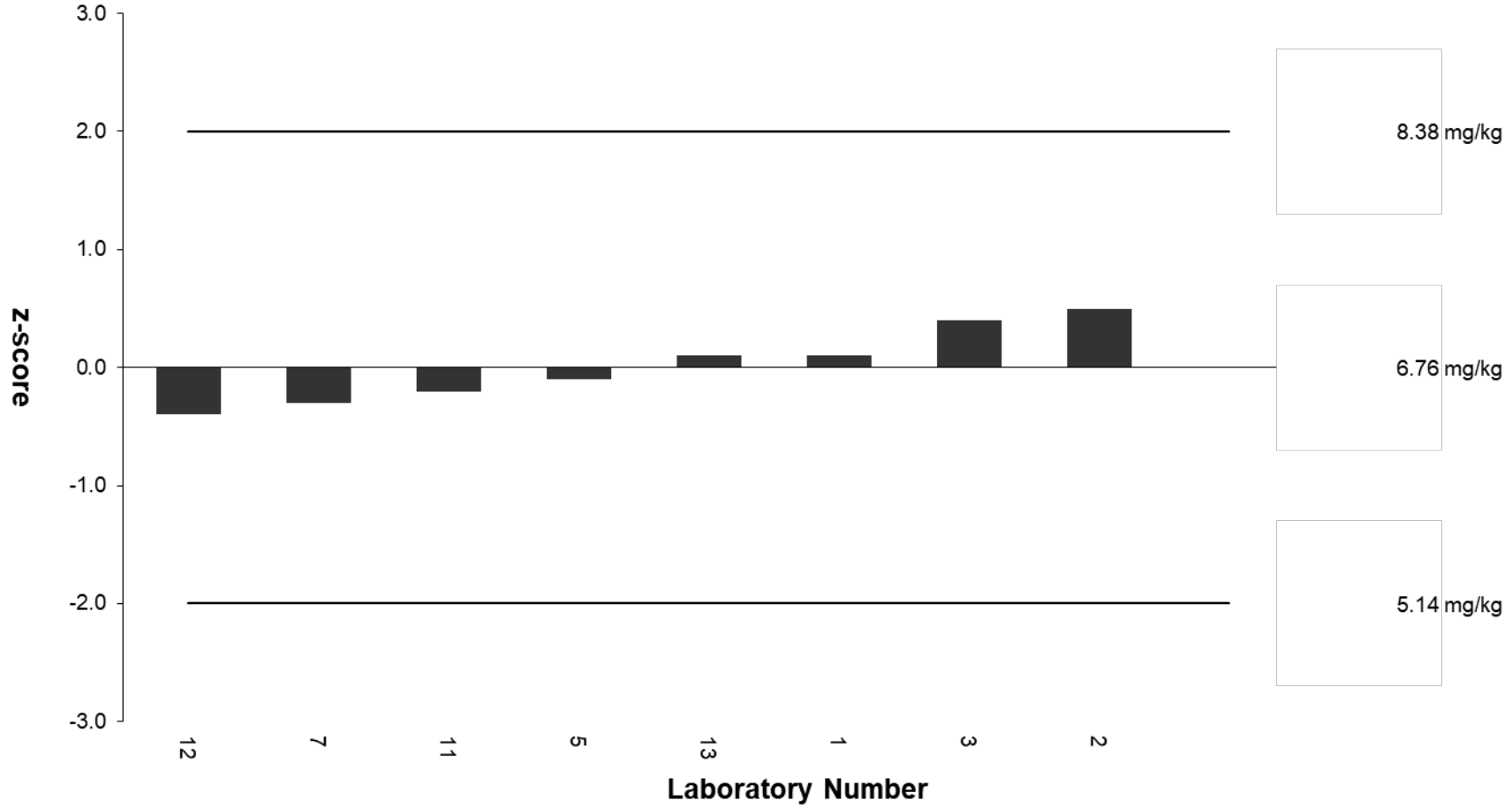

Figure 5: z-Scores for Cobalt

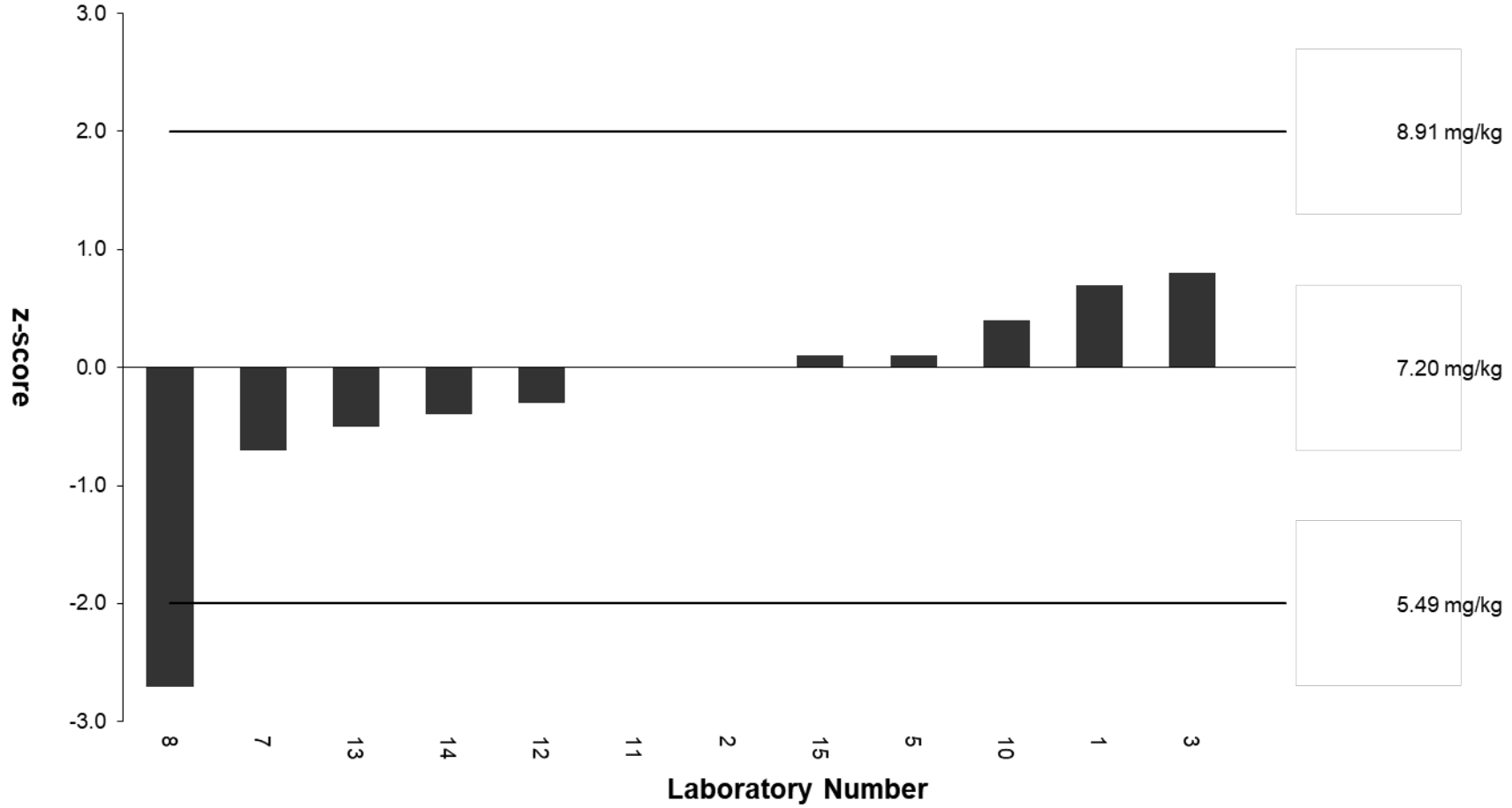

Figure 6: z-Scores for Lead

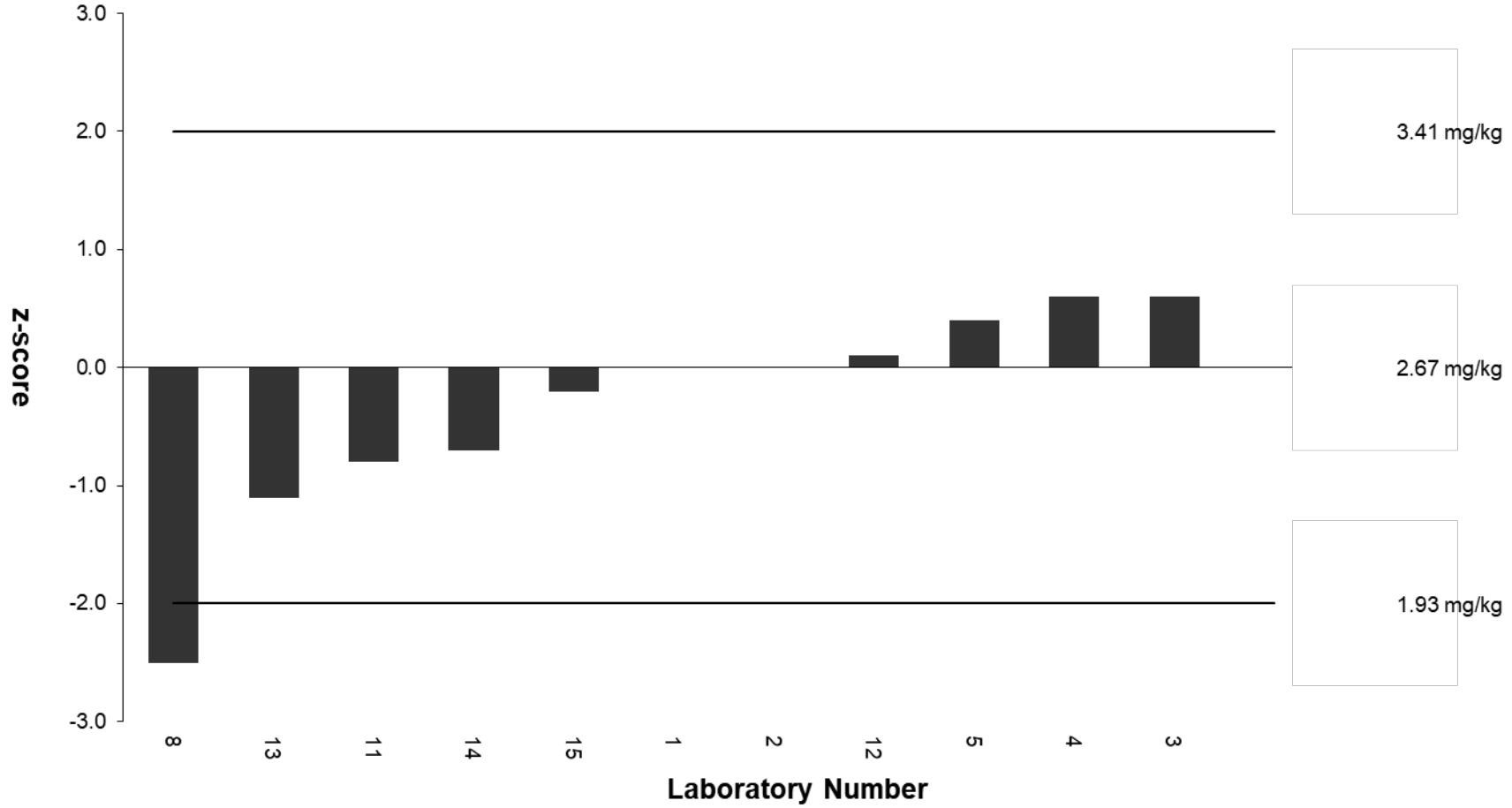

Figure 7: z-Scores for Mercury (total)

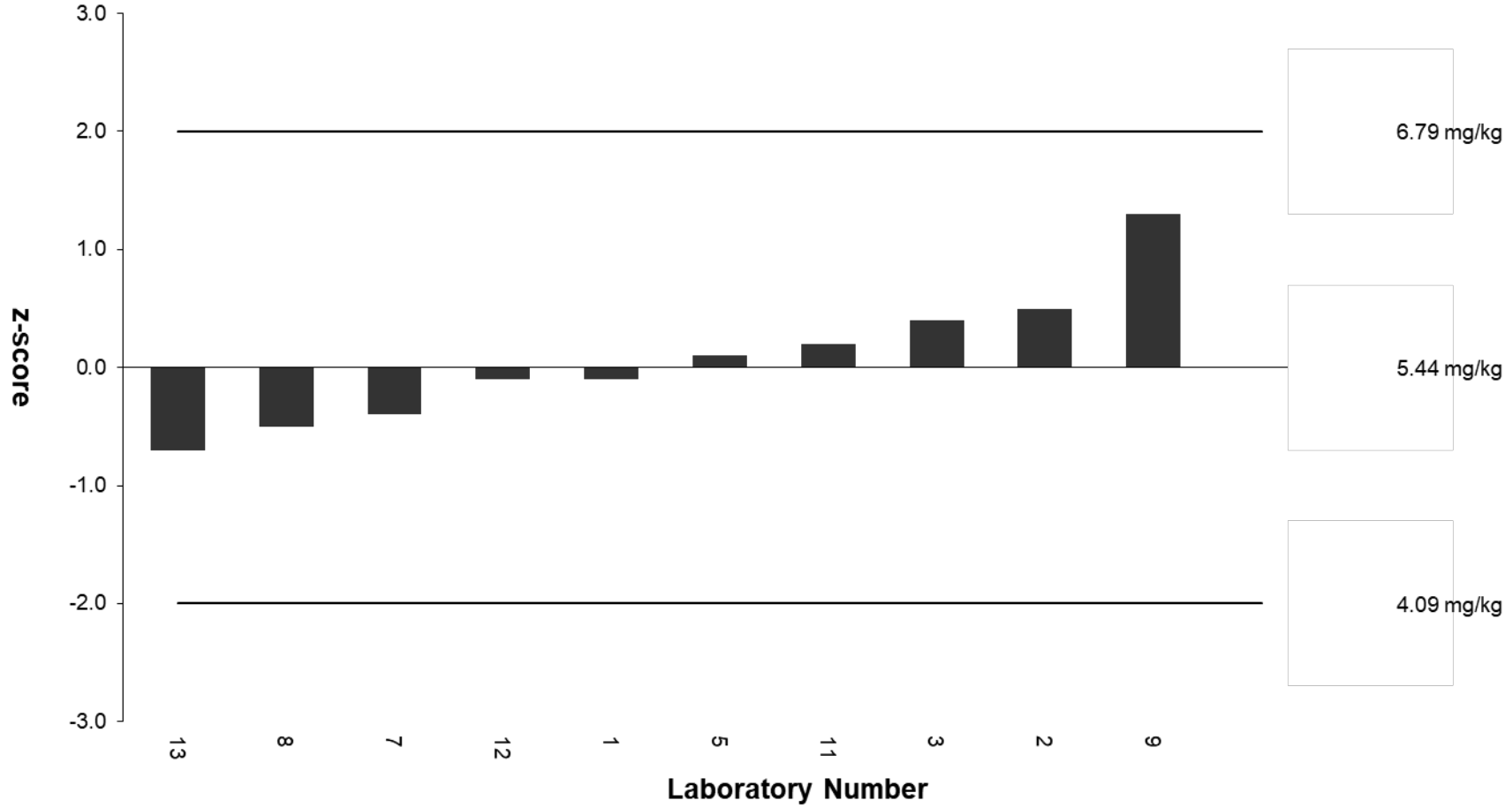

Figure 8: z-Scores for Nickel

APPENDIX I: Analytical Methods Used by Participants

Methods are tabulated according to the information supplied by participants, but some responses may have been combined or edited for clarity. Text that appears as unreadable symbols are derived from entries made using non-Western characters.

Is the Method Used Accredited?	laboratory number
no	003 004 005 007 008
yes	001 002 006 009 010 011 013 014

What is Your Method Based On?	laboratory number
International Standard	004 005 007 013
National Standard	002 006 009 010
In house method	001 003 008 011 014

Arsenic (total)

Sample Weight (g)	laboratory number
<1	001 002 003 005 007 008 010 011 013
≥5 - <10	014

Sample Preparation	laboratory number
microwave digestion	001 002 003 005 007 010 011 013
wet digestion	014
Screening XRF method - sample analysed as received.	008

Sample Preparation Reagents Used	laboratory number
hydrochloric acid	001 005 007 011
hydrogen peroxide	013
nitric acid	001 003 005 010 011 013 014

Determination	laboratory number
ICP-MS	001 002 003 005 007 010 011 013
ICP-OES	014

Wavelength (nm)	laboratory number
188.980	014

Mass (amu)	laboratory number
75	001 003 007 011 013

Limit of Detection	laboratory number
≥0.001 - <0.01	010
≥0.01 - <0.1	014
≥0.1 - <1	002 003 007 011 013

Units of Limit of Detection	laboratory number
milligrams per kilogram (mg/kg)	002 003 007 010 011 013
milligrams per litre (mg/l)	014

Antimony

Sample Weight (g)	laboratory number
<1	001 002 005 007 013
≥5 - <10	014

Sample Preparation	laboratory number
microwave digestion	001 002 005 007 013
wet digestion	014

Sample Preparation Reagents Used	laboratory number
hydrochloric acid	001 005 007
hydrogen peroxide	013
nitric acid	001 005 013 014

Determination	laboratory number
ICP-MS	001 002 005 007 013
ICP-OES	014

Wavelength (nm)	laboratory number
217.582	014

Mass (amu)	laboratory number
121	001
123	007 013

Limit of Detection	laboratory number
≥0.01 - <0.1	014
≥0.1 - <1	002 007 013

Units of Limit of Detection	laboratory number
milligrams per kilogram (mg/kg)	002 007 013
milligrams per litre (mg/l)	014

Cadmium

Sample Weight (g)	laboratory number
<1	001 002 003 005 006 007 008 011 013
≥5 - <10	014

Sample Preparation	laboratory number
microwave digestion	001 002 003 005 006 007 011 013
wet digestion	014
Screening XRF method - sample analysed as received.	008

Sample Preparation Reagents Used	laboratory number
hydrochloric acid	001 005 007 011
hydrogen peroxide	006 013
nitric acid	001 003 005 006 011 013 014

Determination	laboratory number
flame AAS	006
ICP-MS	001 003 005 007 011 013
ICP-OES	002 014

Wavelength (nm)	laboratory number
214.439	014
228.8	006

Mass (amu)	laboratory number
111	003 007 011 013
114	001

Limit of Detection	laboratory number
≥0.01 - <0.1	003 014
≥0.1 - <1	002 007 011 013

Units of Limit of Detection	laboratory number
milligrams per kilogram (mg/kg)	002 003 007 011 013
milligrams per litre (mg/l)	014

Chromium

Sample Weight (g)	laboratory number
<1	001 002 003 005 007 011 013

Sample Preparation	laboratory number
microwave digestion	001 002 003 005 007 011 013

Sample Preparation Reagents Used	laboratory number
hydrochloric acid	001 005 007 011
hydrogen peroxide	013
nitric acid	001 003 005 011 013

Determination	laboratory number
ICP-MS	001 002 003 005 007 011
ICP-OES	013

Mass (amu)	laboratory number
267.716	013
52	001 003 007 011

Limit of Detection	laboratory number
≥0.1 - <1	002 007 013
≥1 - <10	003 011

Units of Limit of Detection	laboratory number
milligrams per kilogram (mg/kg)	002 003 007 011 013

Cobalt

Sample Weight (g)	laboratory number
<1	001 002 003 005 007 011 013

Sample Preparation	laboratory number
microwave digestion	001 002 003 005 007 011 013

Sample Preparation Reagents Used	laboratory number
hydrochloric acid	001 005 007 011
hydrogen peroxide	013
nitric acid	001 003 005 011 013

Determination	laboratory number
ICP-MS	001 002 003 005 007 011
ICP-OES	013

Wavelength (nm)	laboratory number
228.616	013

Mass (amu)	laboratory number
59	001 003 007 011

Limit of Detection	laboratory number
≥0.01 - <0.1	003
≥0.1 - <1	002 007 011 013

Units of Limit of Detection	laboratory number
milligrams per kilogram (mg/kg)	002 003 007 011 013

Lead

Sample Weight (g)	laboratory number
<1	001 002 003 005 007 008 010 011 013
≥5 - <10	014

Sample Preparation	laboratory number
microwave digestion	001 002 003 005 007 010 011 013
wet digestion	014
Screening XRF method - sample analysed as received.	008

Sample Preparation Reagents Used	laboratory number
hydrochloric acid	001 005 007 011
hydrogen peroxide	013
nitric acid	001 003 005 010 011 013 014

Determination	laboratory number
ICP-MS	001 002 003 005 007 011 013
ICP-OES	014

Wavelength (nm)	laboratory number
220.353	014

Mass (amu)	laboratory number
206 207 208	001
206,207,208	003
208	007 011 013

Limit of Detection	laboratory number
≥0.01 - <0.1	010 014
≥0.1 - <1	002 003 007 013
≥1 - <10	011

Units of Limit of Detection	laboratory number
milligrams per kilogram (mg/kg)	002 003 007 010 011 013
milligrams per litre (mg/l)	014

Mercury (total)

Sample Weight (g)	laboratory number
<1	001 002 003 004 005 008 011 013
≥5 - <10	014

Sample Preparation	laboratory number
microwave digestion	001 002 003 005 011 013
wet digestion	014
Screening XRF method - sample analysed as received.	008

Sample Preparation Reagents Used	laboratory number
hydrochloric acid	001 005 011
hydrogen peroxide	013
nitric acid	001 003 005 011 013 014

Determination	laboratory number
automated mercury analyser	004
ICP-MS	001 002 003 005 011 013
ICP-OES	014

Wavelength (nm)	laboratory number
194.164	014

Mass (amu)	laboratory number
202	001 003 011 013

Limit of Detection	laboratory number
≥0.001 - <0.01	004
≥0.01 - <0.1	014
≥0.1 - <1	002 003 011 013

Units of Limit of Detection	laboratory number
micrograms per litre (mg /l)	004
milligrams per kilogram (mg/kg)	002 003 013
milligrams per litre (mg/l)	014

Nickel

Sample Weight (g)	laboratory number
<1	001 002 003 005 007 008 011 013

Sample Preparation	laboratory number
microwave digestion	001 002 003 005 007 011 013
Screening XRF method - sample analysed as received.	008

Sample Preparation Reagents Used	laboratory number
hydrochloric acid	001 005 007 011
hydrogen peroxide	013
nitric acid	001 003 005 011 013

Determination	laboratory number
ICP-MS	001 002 003 005 007 011 013

Mass (amu)	laboratory number
60	001 003 007 011 013

Limit of Detection	laboratory number
≥0.1 - <1	002 003 007 013
≥1 - <10	011

Units of Limit of Detection	laboratory number
milligrams per kilogram (mg/kg)	002 003 007 011 013

APPENDIX II: Fapas® SecureWeb, Protocol and Contact Details

1. Fapas® SECUREWEB

Access to the secure area of our website is only available to participants in our proficiency tests. Please contact us if you require a UserID and Password. Fapas® SecureWeb allows participants to:

- Obtain their laboratory numbers for the proficiency tests in which they have participated.
- View the results they submitted in past and current proficiency tests.
- Submit their results and methods for current tests.
- Review future tests they have ordered.
- Order proficiency tests, reference materials and quality control materials.
- Freely download copies of reports (PDF file), of proficiency tests in which they have participated.
- Use the Enhanced Reporting facility to interactively scrutinise essential elements of this report, including viewing charts of their z-scores obtained in previous Fapas® – Food Chemistry proficiency tests.

2. PROTOCOL

The Protocols [6, 7] set out how Fapas® – Food Chemistry is organised. Copies can be downloaded from our website.

3. CONTACT DETAILS

This report was prepared and authorised on behalf of Fapas® by Krystian Bukowski-Hassall (Round Coordinator). Participants with any comments or concerns about this proficiency test should contact:

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