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LABORATORY NUMBER: Available to participants from FAPAS SecureWeb

FAPAS® Proficiency Test 2258

Deoxynivalenol in Animal Feed

August – September 2009

Report

Prepared on behalf of FAPAS® by

Paul Hauk

UKAS PROFICIENCY TESTING 0009 PT

SUMMARY

1. The test material for FAPAS® Proficiency Test 2258 was dispatched in August 2009. Each participant received an animal feed test material to be analysed for deoxynivalenol (DON). In total, 68 sets of test material were distributed to participants in 28 countries. Of these, 58 participants, i.e. 85%, returned results for the analyte within the time-scale demanded by the Scheme.

2. The assigned value ($\hat{X}$) was calculated from the most appropriate measure of central tendency of participants' results [1, 2, 3].

3. The target standard deviation (σ_p) was derived from the appropriate form of the Horwitz equation [4] and in conjunction with the assigned value ($\hat{X}$), was used to derive z-scores for participants' results. z-Scores are considered satisfactory if $|z| \leq 2$.

4. Results for this test are summarised as follows:

analyte	assigned value, $\hat{X}$ µg/kg	number of satisfactory scores $\|z\| \leq 2$	total number of scores	satisfactory %
DON	991	50	58	86

5. Surplus test materials are available for sale, see APPENDIX III.

6. Whereas this report has been produced in good faith and in accordance with best industry practice, neither the Food and Environment Research Agency nor the Secretary of State for Environment, Food and Rural Affairs accepts any liability whatsoever as to the application or use of the information contained therein.

CONTENTS

1. INTRODUCTION

1.1. Proficiency Testing

The demand for independent proof of competence from regulatory bodies and customers means that proficiency testing is relevant to all laboratories testing food and feed for quality and safety in every country. Hence, it is a requirement of accreditation to ISO 17025 [5] that the laboratory takes part in a proficiency testing scheme, if a suitable scheme exists. Further, for laboratories entrusted with the official control of food and feeds, Article 12 of EU Regulation (EC) 882/2004 [6] requires such laboratories to be assessed and accredited in accordance with ISO 17025, i.e. proficiency testing is a legal requirement for these laboratories. Thus, together with the use of validated methods, proficiency testing is an essential element of laboratory quality assurance.

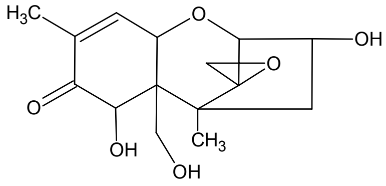
The analysis of an external quality check sample as part of a laboratory's routine procedures provides objective standards for individual laboratories to perform against and permits them to compare their analytical results with those from other laboratories. Such standards and comparisons can go beyond the actual chemical analysis. For example, the ability to report results in specified units and within a given time scale are important aspects of quality. Hence, participants in FAPAS® who submit results after the closing date of a test are only included in the statistical evaluation if there are extenuating circumstances.

It is important to understand the statistical limitations of this external means of quality assessment when gauging the competence of a laboratory. The results of a typical chemical analysis will be normally distributed. That is to say, the majority of results will be centred on a mean value but, inevitably, some results will lie at the extremes of the distribution. The statistics of a normal distribution mean that about 95% of data points will lie between a z-score of –2 and +2. Performance in a FAPAS® proficiency test, therefore, is considered 'satisfactory' if a participant's z-score lies within this range. It follows that if a participant's z-score lies outside $|z| > 2$ there is about a 1 in 20 chance that their result is in fact an acceptable result from the extreme of the distribution. If a participant's z-score lies outside $|z| > 3$ the chance that their result is actually acceptable is only about 1 in 300.

1.2. Fusarium Toxins: Deoxynivalenol

Fusarium toxins, produced by moulds, are examples of toxic substances collectively known as mycotoxins. There are a huge number of mycotoxins, with a wide range of toxic effects. Since foodstuffs such as cereal crops, dried fruit, nuts, spices and fruit juices can be infected by moulds during their growth or storage, mycotoxins can be found as contaminants in these foods. They may be present in food without any obvious sign of fungal growth.

Certain *Fusarium* spp., which are common soil fungi, are probably the most prevalent toxin-producing fungi of the northern temperate regions. They are commonly found on cereals grown in Europe, Asia and America. These *Fusarium* spp. produce a number of different mycotoxins, known as tricothecenes (e.g. DON) and some other toxins (ZON and fumonisins) and are regulated within the European Union (EU) [7]. DON is the most widely found of the tricothecenes, which inhibit protein synthesis, RNA and DNA synthesis, and have immunosuppressive and haemorrhaging effects, particularly in swine [8].



Deoxynivalenol

2. TEST MATERIAL

2.1. Preparation

The test material was prepared by a laboratory contracted to do so by FAPAS®.

A 1 kg portion of chicken feed was screened and then spiked with DON to produce a material containing approximately 1000 µg/kg DON, and was left overnight to vent the solvent. This spiked portion of feed was milled using a 1 mm screen before milling the remainder of the chicken feed.

The spiked portion of milled chicken feed was mixed with incremental portions of the unspiked milled chicken feed using a bowl mixer. After all the unspiked material had been added, the mixture was left to mix overnight.

Individual sub-samples of the test material (≥55 g) were dispensed into foil sachets and stored in a freezer (–20°C) until dispatch.

2.2. Homogeneity

Ten randomly selected test materials were analysed in duplicate for DON by a laboratory contracted by FAPAS®. The results, together with their statistical evaluation [9], are given in APPENDIX I. The statistical tests initially check the data for any widely discrepant pairs using Cochran's test. If found, such data are removed. Thereafter the remaining data are subject to analysis of variance (ANOVA) to estimate the sampling and analytical variances.

These data show sufficient homogeneity and are not included in the subsequent calculation of the assigned value.

2.3. Distribution

Each participant received an individually numbered animal feed test material packed in a padded envelope together with a covering letter, electronic submission instructions and results form (for participants without internet access). The dispatch date was 14 August 2009.

3. RESULTS

Participants were required to report their data in µg/kg, corrected for recovery, together with the percentage recovery. Results were submitted by 58 participants before the closing date for this test, 16 September 2009.

Each participant was given a laboratory number, assigned in order of receipt of results. The reported DON concentrations are given in Table 1.

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

4. STATISTICAL EVALUATION OF RESULTS

The object of the statistical procedure employed is to obtain a simple and transparent result, which the participant and other interested parties can readily appreciate. Further details, including worked examples, are given in the FAPAS® Protocol [1]. The procedure follows that recommended in the IUPAC/ISO/AOAC International Harmonised Protocol for the Proficiency Testing of (Chemical) Analytical Laboratories [10].

4.1. Calculation of the Assigned Value, $\hat{X}$

The assigned value, $\hat{X}$, i.e. the best estimate of the true concentration of DON, was set as the consensus of the results submitted by participants [1, 2, 3]. The procedure used to derive this consensus involved where necessary:

- Removing non valid data, i.e.:
  - i) results from participants not quoting a percentage recovery or stating uncorrected,
  - ii) results reported as 10x greater or less than the majority of submitted results, (as these were considered to be reporting errors),
  - iii) semi quantitative results e.g. >700.
- Considering the normality (Kolmogorov-Smirnov test), or otherwise, of the distribution of results.
- Minimising the influence of outliers by the use of a robust statistical procedure to derive the mean [3].
- Assessing the standard uncertainty (u) of the robust mean:

$$u = \frac{\hat{\sigma}}{\sqrt{n}}$$

where $\hat{\sigma}$ = the robust standard deviation [3]
Note: this is NOT the target standard deviation for the test (σ_p)

and n = the number of data points used to calculate the robust mean.

This procedure was straightforward, the consensus robust mean was used to set the assigned value and together with u, n and $\hat{\sigma}$ is shown in Table 2.

4.2. Target Standard Deviation for the Test, σ_p

The value of σ_p determines the limits of satisfactory performance in a FAPAS® proficiency test. It is set at a value that reflects best practice for the analyses in question. The standard deviation of reproducibility found in collaborative trials is generally considered an appropriate indicator of the best agreement that can be obtained between laboratories. However, not all analyses have been characterised in this manner. In such cases, the predictive models of the appropriate form of the Horwitz equation [4] are valuable indicators of best practice.

For DON, σ_p was derived from the appropriate form of the Horwitz equation [4]. This equation predicts a standard deviation from a given concentration, *c*, and requires *c* to be expressed as a dimensionless mass ratio, e.g. 1 ppm ≡ 10^{-6} or % ≡ 10^{-2}. It follows therefore that to express the dimensionless standard deviation predicted by the equation in the original concentration units it must be divided by the relevant mass ratio.

i) for analyte concentrations <120 ppb

$$\sigma_p = \frac{0.22c}{mr}$$

ii) for analyte concentrations ≥120 ppb and ≤13.8%

$$\sigma_p = \frac{0.02c^{0.8495}}{mr}$$

iii) for analyte concentrations >13.8%

$$\sigma_p = \frac{0.01c^{0.5}}{mr}$$

where, in all three cases, *c* = concentration, i.e. the assigned value, $\hat{X}$, expressed as a dimensionless mass ratio, e.g. 1 ppm ≡ 10^{-6} or % ≡ 10^{-2}

and *mr* = dimensionless mass ratio, e.g. 1 ppm ≡ 10^{-6} or % ≡ 10^{-2}.

The value of σ_p used to calculate z-scores from the reported results in this test is shown in Table 2.

4.3. Individual z-Scores

Participants' z-scores were calculated as:

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

where x = the participant's reported result,
$\hat{X}$ = the assigned value
and σ_p = the target standard deviation.

Participants' z-scores for DON are given in Table 1 and shown as a histogram in Figure 1.

The number and percentage of z-scores in the satisfactory range, $|z| \leq 2$, for DON are given in Table 3.

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 value and target standard deviation prior to their publication in Table 2.

5. REFERENCES

1 FAPAS®, 2002, *Protocol for the Organisation and Analysis of Data*, 6th Edition.

2 Lowthian, P.J. and Thompson, M., 2002, Bump-hunting for the proficiency tester – searching for multimodality, *Analyst*, **127**, 1359-1364.

3 Analytical Methods Committee, 1989, Robust Statistics – How not to reject outliers Part 1. Basic Concepts, *Analyst*, **114**, 1693-1697.

4 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.

5 ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories.

6 Regulation (EC) No. 882/2004 of the European Parliament and of the Council of 29 April 2004 on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules, *Official Journal,* **L 165**, 30/04/2004, 0001-0141.

7 Regulation (EC) No. 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs, *Official Journal,* **L 364**, 20/12/2006, 0005-0024.

8 Langseth, W. and Rundberget, T., 1998, Instrumental methods for determination of nonmacrocyclic tricothecenes in cereals, foodstuffs and cultures, *Journal of Chromatography A*, **815**, 103-121.

9 Fearn, T. and Thompson, M., 2001, A new test for 'sufficient homogeneity', *Analyst*, **126**, 1414-1417.

10 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*., **Vol. 78, No. 1**, 145-196.

Table 1: Results and z-Scores for DON in Animal Feed Test Material

laboratory number	analyte		
	DON		
	assigned value	991	µg/kg
	result µg/kg	recovery %	z-score
001	740	100	-1.6
002	897	uncorr	-0.6
003	983	95	-0.1
004	1312	70	2.0
005	958.5	90	-0.2
006	1045	uncorr	0.3
007	1194	95	1.3
008	876	72	-0.7
009	1090	uncorr	0.6
010	0.951	102	**-6.2**
011	760	100	-1.5
012	1191.4	88	1.3
013	1024	88.5	0.2
014	1067.78	81.40	0.5
015	1080	uncorr	0.6
016	2010	n/a	**6.4**
017	946.28	uncorr	-0.3
018	810.3	100.5	-1.1
019	855	uncorr	-0.9
020	1477	100	**3.1**
021	1050	uncorr	0.4
022	1051	103	0.4
023	1000	uncorr	0.1
024	1005	73	0.1
025	1205	77	1.3
026	1086.38	86	0.6
027	1060	uncorr	0.4
028	1079.29	90.54	0.6
029	917.64	77.5	-0.5
030	944	100	-0.3
031	989.0	80.0	0.0
032	1114.3	94.75	0.8
033	1000	87.3	0.1
034	1041.50	89	0.3
035	856	96	-0.9
036	908	96.5	-0.5
037	853.16	69.68	-0.9
038	1028	100	0.2
039	1038	102	0.3
040	822	95	-1.1

uncorr = participant did not state recovery
z-scores outside the satisfactory rangei.e. |z| >2, are shown in **bold**

Table 1 (Continued): Results and z-Scores for DON in Animal Feed Test Material

laboratory number	analyte		
		DON	
	assigned value	991	µg/kg
	result µg/kg	recovery %	z-score
041	1268.3	123	1.7
042	1245.18	100	1.6
043	931	95	-0.4
044	665	92.5	**-2.1**
045	940	91	-0.3
046	1068	90	0.5
047	830	95	-1.0
048	1200	94	1.3
049	1278	69	1.8
050	1055	89	0.4
051	1053	95	0.4
052	730	70	-1.6
053	564	uncorr	**-2.7**
054	981	uncorr	-0.1
055	800	106	-1.2
056	460	100	**-3.3**
057	638	uncorr	**-2.2**
058	615	80	**-2.4**

uncorr = participant did not state recovery
z-scores outside the satisfactory range i.e. |z| >2, are shown in **bold**

Table 2: Assigned Values and Target Standard Deviations

analyte	assigned value, µg/kg				target standard deviation	
	data points, n	robust mean, $\hat{X}$	robust standard deviation, $\hat{\sigma}$	uncertainty, u	derived from	σ_p
DON	44	991	194	29	Horwitz*	159

* see page 7 for the appropriate form of the Horwitz equation.

Table 3: Number and Percentage of Satisfactory z-Scores

analyte	number of satisfactory scores $\|z\| \leq 2$	total number of scores	satisfactory %
DON	50	58	86

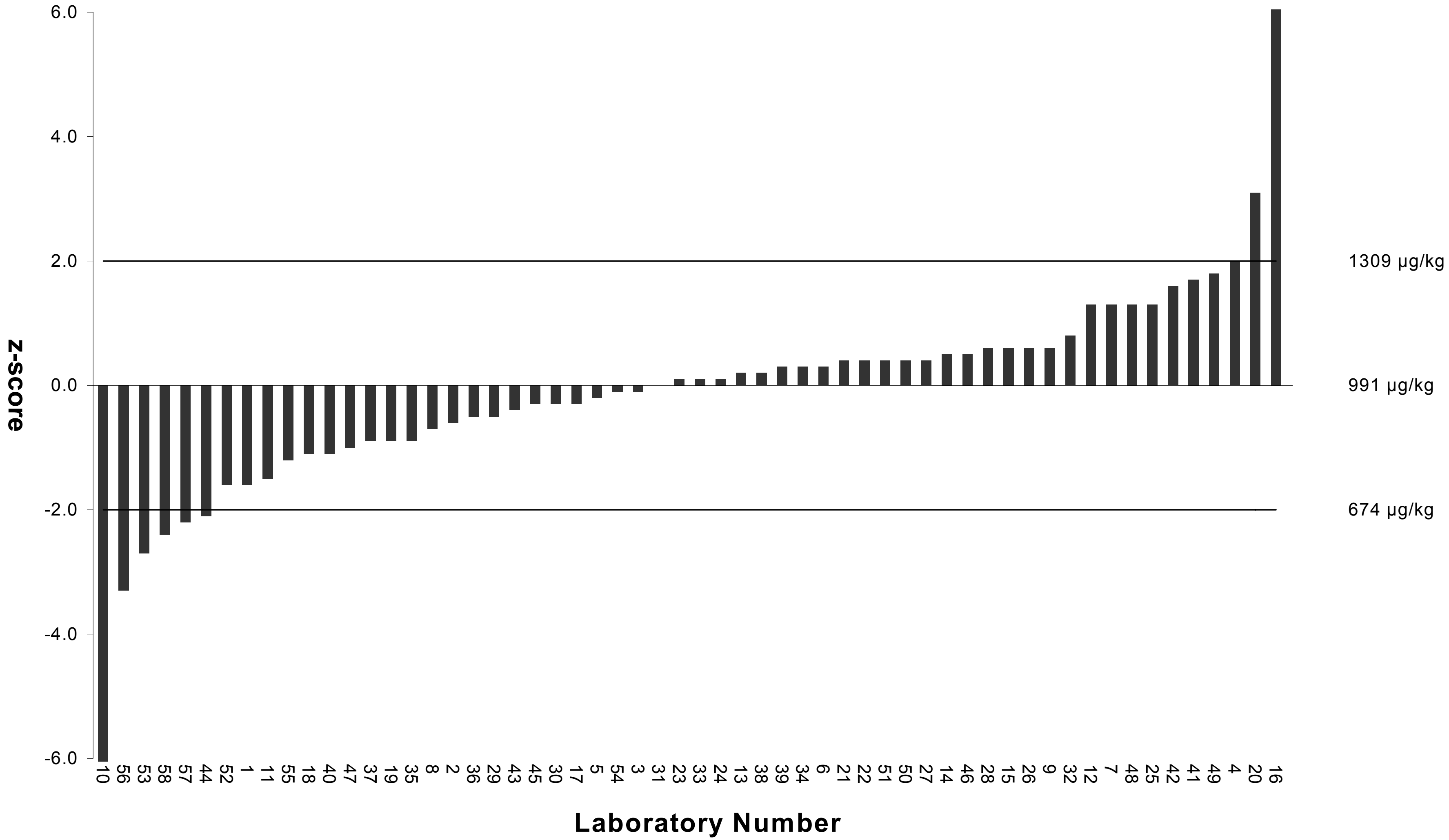


Figure 1: z-Scores for DON (991 µg/kg) in Animal Feed Test Material

APPENDIX I: Homogeneity Data for Animal Feed Test Material

sample identity	analyte	
	DON µg/kg	
	replicate 1	replicate 2
1	1023	1029
2	966	1011
3	1033	1008
4	1013	1016
5	1019	1054
6	997	999
7	1002	1017
8	1041	1026
9	1093	1065
10	1016	1066
mean	1025	
n	20	
origin of target sd (σ_p)	Horwitz original*	
abs. target sd (σ_p)	163	
abs. target sd as RSD%	15.9	
s_{an}	19.6	
s_{sam}^2	452	
σ_{all}^2	2400	
critical	4899	
s_{sam}^2<*critical?*	**ACCEPT**	

* see page 7 for the appropriate form of the Horwitz equation

APPENDIX II: Analytical Methods Used by Participants

1) Participants' methods are tabulated according to the information submitted electronically, but some responses may have been combined or edited for clarity.

2) Participants with performance |z| >2 are no longer shown in bold within this Appendix. Refer to Table 1 for this information.

Accredited Method Used	laboratory number
yes	002 003 005 006 008 009 010 011 019 020 021 023 026 028 029 032 034 035 037 039 040 043 044 046 048 049 050 051 052 053 054 058
no	004 015 016 017 018 022 024 027 030 031 033 036 038 041 042 045 047 055 056 057

Reference	laboratory number
AFNOR pr NF EN 15891	030
AFNOR 2006	048
Analyst	028
AOAC Official Methods	041
AOAC Official Methods 1998 J AOAC Vol. 81 No. 4, AOAC Peer verified method PVM 2 1997 880-886	044
AOAC Official Methods 2000	019
AOAC Official Methods 2002 000701 Certificate no. FGIS 2002-105	027
AOAC Official Methods 2005 986.17 42	034
AOCS 2002	010
Collab.trial protocol No131 2002	040
Donprep® Application Note–Cereal–Deoxynivalenol Extraction Method, Application Note for analysis of Deoxynivalenol in Cereal Ref. No. A1–P50.V4, Oct. 2008.	032
Food Additives and Contaminant	039
ISO FprEN 15791	045
J. Anal. chem. 371, 285-299 2001	003
J. AOAC Int. 2006	048
Manufacturer's Instructions	009 017 026 047 050

Reference (continued)	laboratory number
Methods of Analysis in Feeds, Japan 2004 5-53	018
Ridascreen Fast DON 2002	023
RIKILT-method	011
Römer Labs 2004	029
USDA	055
VDLUFA 2006	043
VICAM Instruction Manual 1999	053
VICAM 2002	037

Sample Weight (g)	laboratory number
≥1 - <2	038 051
≥2 - <5	011 015 016 017 023
≥5 - <10	006 010 018 019 020 021 022 026 027 028 035 043 046 054
≥10 - <25	003 004 005 024 029 030 033 036 039 040 041 047 049 050 052 057
≥25 - <50	002 007 008 009 031 032 034 037 042 044 045 053 055 056 058

Extraction Solvent	laboratory number
acetic acid	036
acetonitrile	002 004 008 009 011 018 020 024 029 031 034 036 039 040 043 044 046 051 057 058
methanol	041 052
water	002 003 004 005 006 007 008 009 010 011 015 016 017 018 020 021 022 023 024 026 027 028 029 030 031 032 033 034 035 036 037 038 039 040 041 042 043 044 045 046 047 049 050 051 052 053 054 055 056 057 058

Extraction Procedure	laboratory number
blend / homogenise with solvent	008 028 031 032 037 041 042 044 045 048 055 058
hot water extraction	043
maceration / homogenisation	056
shake with solvent	002 004 005 006 007 009 011 015 018 020 021 022 024 026 027 029 030 033 034 035 036 038 039 040 046 047 051 052 053
shaking	003 016 023 028 057
sonicate/ultrasonic bath	049 057
ultra turrax	050 054
ultrasonic extraction	017
vortex mix	010

Extraction Type	laboratory number
single	002 003 004 005 006 007 008 009 011 016 017 018 020 021 022 023 024 026 027 028 029 030 031 032 033 034 035 036 037 038 039 040 041 042 043 044 046 048 049 050 051 052 053 054 055 056 057 058
multiple	010 015 045

Extraction Time	laboratory number
1 minutes	050
2 minutes	042 043 045
3 minutes	007 017 021 023 055
4 minutes	056
5 minutes	010 022 027
10 minutes	015 038
15 minutes	006 057
30 minutes	003 005 018 034 035 053
40 minutes	047
45 minutes	046
60 minutes	002 029 033 036 040 044 052
120 minutes	004 009 011 020 030 039

Sample Work Up	laboratory number
centrifuge	005 010 011 015 029 030 032 038 041 042 043 047 051 055 056
dilute	002 028 038 040 048 058
evaporate	028 034 037 042 046 051
filter	003 004 005 007 008 011 017 021 022 023 026 027 028 030 031 032 033 034 035 036 037 039 040 043 044 045 048 049 050 052 053 054 057
pH adjustment	054
none	006 009 018 020

Sample Clean-up by Immunoaffinity Column (Brand)	laboratory number
charcoal, celite, alumina	034
Neogen	030
Neogen NeoColumn	045
R-Biopharm Rhone	003 005 007 027 028 032 033 040 042 043 047 048 050 054 056
VICAM	037 046 049 053 055

Sample Clean-up by SPE	laboratory number
florisil	052
Romer Labs	008 009 018 020 023 029 031 036 040
Micotox	044
charcoal/alumina	039
charcoal/alumina/celite 25/35/15	004
charcoal-alumina-celite	034
Mycosep	046

Mycotoxin Determination	laboratory number
ELISA	006 010 015 016 017 019 021 022 023 026 027 036 038 041
GC	009 031 039 056
HPLC	002 003 004 005 007 008 020 024 028 030 032 033 034 035 037 040 042 043 044 045 047 048 049 050 051 052 053 054 055 057 058
LC/MS/MS	011 018 029 046

HPLC Pre Column Derivatisation	laboratory number
none	004 007 018 020 023 028 029 033 035 037 042 043 044 046 050 053 055

HPLC Injection Volume (μL)	laboratory number
<5	018 051 057
≥5 - <10	046
≥10 - <25	002 011 020 023 029 035 039 043 045 058
≥25 - <50	037 052
≥50 - <100	003 007 008 024 028 044 049 050 053
≥100 - <150	004 005 032 033 034 042 047 048 054 055
≥150	030 040

HPLC Column Packing	laboratory number
C18	002 003 004 005 007 008 011 018 020 023 024 028 029 030 032 033 034 037 040 042 043 044 045 046 047 048 049 050 051 052 053 054 057
C18 XDB	058
C8	035
endcapped	002 004 008 043 054
Synergi Polar (Phenomenex)	055

HPLC Column Temperature (°C)	laboratory number
ambient	004 005 028 030 034 035 040 047 049 055
>ambient - <50	002 003 007 008 011 018 020 023 029 032 033 037 042 043 044 045 046 048 050 051 052 053 057 058
≥50	024

Mobile Phase Components	laboratory number
acetate	024 046 058
acetic acid	040
acetonitrile	002 003 004 005 007 008 011 018 023 028 029 032 033 035 043 044 045 047 048 050 053 054 055 058
amonium formate	018
formic acid	002 057 018
methanol	005 007 008 011 020 024 028 030 032 033 034 035 037 040 042 044 045 046 047 049 051 052 057 058
water	003 004 005 007 008 011 018 020 023 024 028 029 030 032 033 034 035 037 040 042 043 044 045 046 047 048 049 050 051 052 053 054 055 057 058

Mobile Phase Flow Rate (mL/min)	laboratory number
<0.25	011 018 020 023 029
≥0.25 - <0.75	002 007 008 024 043 044 046 048 051 052
≥0.75 - <1.25	004 005 028 030 032 033 034 035 037 040 042 047 049 050 053 054 055 057 058
≥1.25 - <1.75	003 045

Post Column Mobile Phase Flow Rate (mL/min)	laboratory number
<0.25	023 029
≥0.25 - <0.75	044
≥0.75	004 042

HPLC Detector Type	laboratory number
Diode Array Detector	005 007 030 034 035 054 055
fluorescence	004 050
MS	058
MS-MS	002 011 018 020 023 024 029 046 051 052 057
UV	003 008 028 032 037 040 042 043 045 047 048 053
UV/Vis	033 044 049

GC Injection Volume (µL)	laboratory number
<1	056
≥1 - <2	039
≥2 - <5	031
≥5 - <10	004

GC Column Packing	laboratory number
100% methyl polysiloxane	056
50% methyl 50% phenyl polysiloxane	031
95% methyl 5% phenyl polysiloxane	039

Column Temp Mode	laboratory number
isothermal	004 039 042 052
gradient	010 011 031 035 037 041 056 058

Carrier Gas	laboratory number
helium	009 031 039
nitrogen (N)	041 056

GC Flow Rate	laboratory number
≥0.75 - <1.25	009 031
constant pressure	039 041

GC Detector	laboratory number
ECD	056
MS	009 031 039

Source of Standards	laboratory number
Biopure	003 020 036
Beacon USA (from kit)	022
LGC	032
Micotox	044
Promochem	054
provided by manufacturer	015
R-Biopharm Rhone	010 016 023 028 042
Romer Labs	029 050 057
Sigma/Aldrich	002 005 007 011 017 024 030 031 034 035 038 039 040 043 045 046 051 052 053 055 056 058
Supelco	049
Trilogy	009
Wako	018

APPENDIX III: FAPAS® SecureWeb, Reports and Protocol

1. FAPAS® SECUREWEB

Access to the secure area of our web site 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 and quality control materials, ***including surplus test materials from the batch used in this proficiency test***.
- Freely download copies of reports, in Acrobat PDF format, of proficiency tests in which they have participated.

2. REPORTS

The Acrobat PDF version of this report is available to all participants as a free download from FAPAS® SecureWeb.

A printed and bound version of this report is priced £35 if ordered at the same time as the proficiency test or £50 if ordered subsequently.

3. PROTOCOL

The Protocol [1] sets out how FAPAS® is organised. It gives full details of the statistical procedures used and includes worked examples. Copies can be downloaded from our website.

4. CONTACT DETAILS

Participants with any comments or concerns about this proficiency test should contact:

FAPAS®

Food and Environment Research Agency
Sand Hutton, York
YO41 1LZ
UK

Tel: +44 (0)1904 462100
Fax: +44 (0)1904 462040
e-mail: info@fapas.com
testmaterials@fapas.com
web: www.fapas.com

The Food and Environment Research Agency is an ISO 9001 certified organisation.