



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFASs in Fish Fillet 2025

EURL-PT-POP_2501-FF

FOOD

Final Report PBDEs and HBCDDs (Report Version 1.0)

13 February 2026



**Funded by
the European Union**

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Health and Digital Executive Agency (HADEA). Neither the European Union nor the granting authority can be held responsible for them.



Summary

Test sample	FOOD: Fish Fillet [2501-FF]
Analytes of interest Mandatory for NRLs:	PBDEs (BDE-28, -47, -49, -99, -100, -153, -154, -183, -209) HBCDDs (α -HBCDD, β -HBCDD, γ -HBCDD or total HBCDD)
Methods	Any kind of method
Participants	NRLs, OFLs, other official laboratories, commercial laboratories performing the analysis of samples taken by food business operators
Statistical evaluation	ISO 13528:2022 [1], IUPAC Protocol [2]
Report of final results	13 February 2026 (Version 1.0)
Publication	EURL POPs reserves all rights to publish and present the anonymised results of the interlaboratory study in scientific journals and/or during conferences.

1. Structure of the PT, test material and analytes

This proficiency test (PT) on the determination of **PCDD/Fs**, **PCBs**, **PBDEs**, **HBCDDs** and **PFASs** in **Fish Fillet** was organized by the EURL for halogenated POPs in Feed and Food to be performed between January and April 2025. The objective was to assess analytical performance of laboratories and interlaboratory comparability of results from analyses of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFASs in one sample of **Fish Fillet**.

National Reference Laboratories (NRLs) for halogenated POPs in Feed and Food from EU member states were requested to participate as part of their work programme for 2025. NRLs were invited to encourage the participation of Official Laboratories (OFLs) from their member states as part of their duties following Article 101 of regulation (EU) 2017/625 of the European Parliament and of the Council of 15 March 2017. Furthermore, participation of OFLs allowed the extension of the data basis for calculation of assigned values and evaluation of results.

First results were discussed by representatives of European Commission, NRLs and the EURL at the EURL/NRL workshop in May 2025 in Barcelona, Spain.

1.1. Samples and coding

The test sample was prepared from regular market food. It was **not fortified** with analytes of interest.

Fish Fillet	Sample no. 2501-FF-xxx
--------------------	-------------------------------

Each participant received about **125 g** of the test sample as a fully preserved canned product.

1.2. Analytes of interest

Participants were requested to determine the following parameters:

Polybrominated diphenyl ethers (PBDEs)

- Individual congeners: BDE-28, -47, -49, -99, -100, -153, -154, -183, -209
- Sum of 8 PBDEs (without BDE-209)
- Sum of 9 PBDEs (with BDE-209)

Hexabromocyclododecanes (HBCDDs)

- α -HBCDD, β -HBCDD, γ -HBCDD stereoisomers
- Sum of α -, β -, γ -HBCDD (using HPLC methods)
- Total HBCDD (using GC methods)

1.3. Methods

All kinds of detection and quantification methods could be applied.

1.4. Coding of laboratories and confidentiality

The identity of participating laboratories will be kept confidential.

For NRLs of EU member states, the suggested “protocol for management of underperformance in comparative testing or lack of collaboration of National Reference Laboratories (NRLs)” will be followed. The confidentiality of NRLs will be kept according to this protocol.

For OFLs of EU member states cooperating with NRL, the respective NRLs will inform the EURL for halogenated POPs about the participating OFLs and will receive the respective laboratory codes, invoices for participation fee and certificates of participation of the OFLs.

1.5. Results of PBDEs and HBCDDs

Laboratories should:

- use their own reference standards for identification and quantification,
- report results for each analyte,
- report the limit of quantification (LOQ), at least for each non-quantified analyte,
- give method information and
- give information about the accreditation of the laboratory according to ISO/IEC 17025 (*for metrological traceability of consensus values of participants used as assigned values*).

Results had to be reported in **$\mu\text{g/kg}$ wet weight (w. w.)** for PBDEs and HBCDDs.

2. Participating laboratories

This proficiency test was open for participation of:

- National Reference Laboratories (NRLs) of EU member states
- National Reference Laboratories of other European countries
- Official laboratories

79 laboratories registered for this proficiency test. For PBDE and HBCDD, 27 and 19 sets of results were reported, respectively. One laboratory submitted two sets of data

Table 1: Participating laboratories

Participating laboratories	Region	No. all participants	No. participants for PBDE/HBCDD
National Reference Laboratories	European Union	24	19
	Other Countries	3	1
Official Laboratories	European Union	52	6
	Total	79	29

2.1. Number of reported results

Table 2: Reported results for PBDEs and moisture content for Fish Fillet (2501-FF)

Reported results (2501-FF)	All laboratories
BDE-28, 47, 99, 100, 153, 154, 183	32
BDE-49, 209	27, 26
Sum of 8 PBDEs (without BDE-209) (ub)	29
Sum of 8 PBDEs (without BDE-209) (lb)	28
Sum of 9 PBDEs (with BDE-209) (ub)	25
Sum of 9 PBDEs (with BDE-209) (lb)	25
Lipid content	23

Table 3: Reported results for HBCDDs for Fish Fillet (2501-FF)

Reported results (2501-FF)	All laboratories
α -, β -, γ -HBCDD	18
Sum of α -, β -, γ -HBCDD (ub)	18
Sum of α -, β -, γ -HBCDD (lb)	18
Total HBCDD (using GC methods)	2

2.2. Accreditation

Table 4: Reported accreditation according to ISO/IEC 17025 by participants for PBDEs and HBCDDs

Fish Fillet	PBDEs	HBCDDs
Accreditation	21	9
No accreditation	9	10

2.3. Detection methods

The following detection methods were applied:

- GC-HRMS-, GC-MS/MS-methods for PBDEs
- GC-HRMS-, GC-MS/MS-, LC-MS/MS-, LC-HRMS-methods for HBCDDs

Table 5: Overview of chromatographic separation and detection methods for the determination of PBDEs and HBCDDs for Fish Fillet (2501-FF)

Detection methods	PBDEs	HBCDDs
GC-HRMS	19	1
GC-MS/MS	10	-
GC-NCI-MS	-	-
LC-MS/MS	-	16
LC-HRMS	-	4

3. Test for sufficient homogeneity and stability

The test for sufficient homogeneity was performed according to ISO 13528:2022 [1] and the International Harmonized Protocol for the Proficiency Testing of Analytical Chemistry Laboratories [2]. Therefore, 10 portions of the test samples 2501-FF were analyzed in duplicate for PBDEs. The test for sufficient homogeneity was performed for the individual congeners and sum parameters. The test materials showed sufficient homogeneity for PBDEs for this proficiency test. This could also be concluded for HBCDDs. The stability check applying room temperature storage was performed for PCDD/Fs and PCBs according to ISO 13528:2022 [1]. The test material showed sufficient stability for PCDD/Fs and PCBs this proficiency test (see Final Report for PCDD/Fs and PCBs) and could also be concluded for PBDEs and HBCDDs.

4. Determination of the assigned value

Statistical evaluation of the PT results was performed by the EURL for halogenated POPs in feed and food according to ISO 13528:2022 [1] and the International Harmonized Protocol for the Proficiency Testing of Analytical Chemistry Laboratories [2].

The determination of the assigned value was performed according [1] by estimating of the assigned value as the consensus of participants' results (using only results of physico-chemical methods). The Huber robust mean was taken as assigned value after excluding extreme outliers (outside the range of $\pm 50\%$ of the median of all reported results) and examination of the distribution of the remaining results using histogram and Kernel density estimation, if necessary.

Assigned values were calculated for individual PBDE congeners, sum of 8 (without BDE-209) and sum of 9 (with BDE-209) PBDEs, for individual HBCDD diastereomers, sum of α -, β - and γ -HBCDD and total HBCDD (including limits of quantification (LOQs)), if possible. Additionally, the median of all values was calculated.

For individual congeners (including LOQs) assigned values were only calculated according to the above mentioned procedure, if more than 2/3 of all results are above the LOQ and less than 1/3 of all results (including LOQs) are outside the range of $\pm 50\%$ of the median of all reported results. Levels for individual congeners are only taken for evaluation and calculation if these levels are equal to or above the LOQ; otherwise, the LOQ will be taken instead.

Due to high variation of participants' results, no assigned values could be calculated for:

- BDE-209
- (+/-)- β -HBCDD; (+/-)- γ -HBCDD
- Total HBCDD (using GC-methods)

Since there are no traceable reference values available, the assigned values in this PT were calculated based on the Huber robust mean of the participants' results. Therefore, the assigned values are only traceable to the results of the participants. Additionally, the results of all

participants reporting results and the results of participants having accreditation according to ISO/IEC 17025 were compared for PBDE sum parameters. 21 of 29 participating laboratories were accredited according to ISO/IEC 17025 for PBDEs. After eliminating outliers, 16 to 17 results contributed to the calculation of the assigned values from the ISO/IEC 17025 group. No significant differences (2 %) between the assigned values calculated for both data sets for PBDEs were observed. (Table 6).

Table 6: Comparison of assigned values for all participants and participants with reported accreditation according to ISO/IEC 17025 for PBDE and HBCDD sum parameters for 2501-FF

Sum parameters	Assigned value All participants	Assigned value ISO/IEC 17025 accreditation	Deviation
	µg/kg wet weight		%
Sum of PBDE without BDE-209 (ub)	0.917	0.931	2
Sum of PBDE without BDE-209 (lb)	0.928	0.948	2

4.1. PBDEs – individual congeners and sum parameter

The assigned values for the test sample 2501-FF were calculated as consensus of participants' results for individual PBDEs and sum parameters, taking into account the calculation criteria described above (Table 7, Figure 1 and 2; tabular summary see annex 1).

Table 7: Assigned values for PBDEs (rounded to three significant figures)

Fish Fillet (2501-FF)	Assigned value µg/kg (wet weight)
BDE-28	0.0154
BDE-47	0.572
BDE-49	0.0446
BDE-99	0.0584
BDE-100	0.151
BDE-153	0.0290
BDE-154	0.0524
BDE-183	0.00102
Sum of 8 PBDEs (without BDE-209) (ub)	0.917
Sum of 8 PBDEs (without BDE-209) (lb)	0.928
Sum of 9 PBDEs (including BDE-209) (ub)	0.959
Sum of 9 PBDEs (including BDE-209) (lb)	0.950

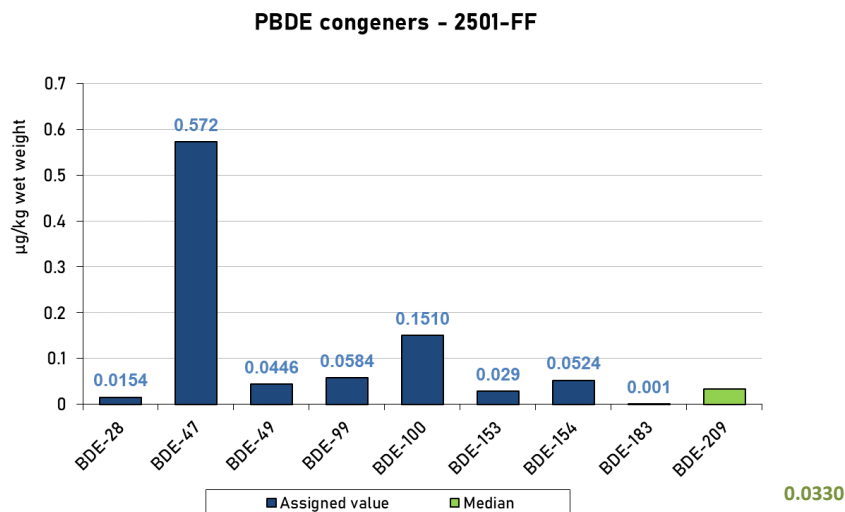


Figure 1: Assigned values (blue) and median values (green) for PBDE individual congeners for Fish Fillet (2501-FF) [µg/kg wet weight]

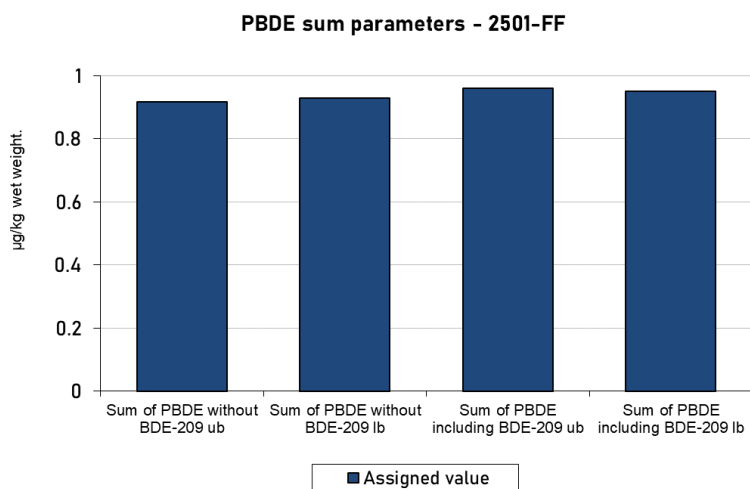


Figure 2: Assigned values (blue) and median values (green) for PBDE sum parameters for Fish Fillet (2501-FF) [µg/kg wet weight]

4.2. HBCDDs – individual stereoisomers and sum parameter

The assigned values for the test sample 2501-FF were calculated as consensus of participants' results for individual HBCDDs and sum parameters, taking into account the calculation criteria described above (Table 8, Figure 2; tabular summary see annex 1).

Table 8: Assigned values for HBCDDs (rounded to three significant figures)

Fish Fillet (2501-FF)	Assigned value µg/kg (wet weight)
(+/-)-α-HBCDD	0.702
Sum of α-, β-, γ-HBCDD (ub)	0.740
Sum of α-, β-, γ-HBCDD (lb)	0.702

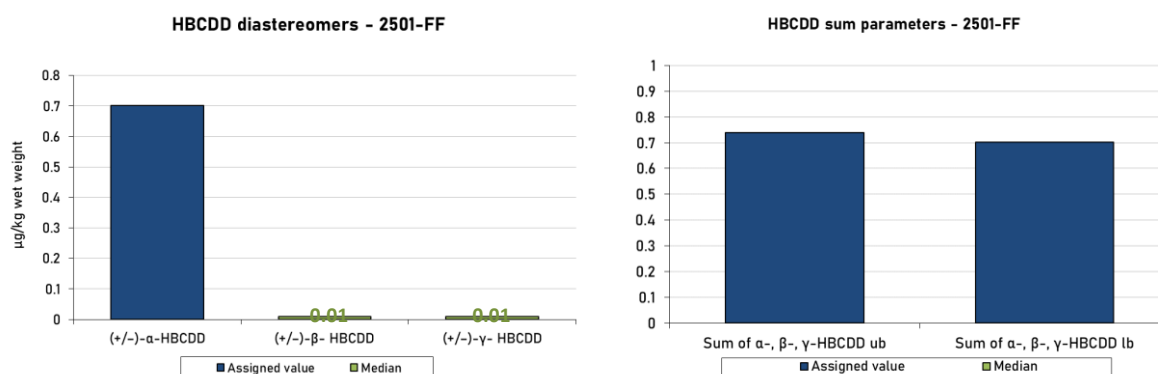


Figure 2: Assigned values (blue) and median values (green) for HBCDD individual congeners and sum parameters for Fish Fillet (2501-FF) [µg/kg wet weight]

4.3. Lipid content

For the lipid content an assigned value of 5.80 % for the test sample 2501-FF was calculated as a consensus of the participants' results, taking into account the calculation criteria described above (tabular summary see annex 1).

4.4. Comparison of assigned values with recommended LOQs

The limits of quantification are currently based on the values specified in Commission Recommendation of 3 March 2014, on the monitoring of trace levels of brominated flame retardants in food (2014/118/EU). For PBDEs the recommended LOQ value is 0.01 µg/kg w.w. for individual congeners (Table 9). In the EURL "Guidance document on analytical parameters for the determination of organobromine contaminants in food and feed", a lower LOQ value of 0.001 µg/kg w.w. is targeted for all congeners except BDE-209, since some foods have concentrations below this value (Table 10; [3]). Valid data on the background contamination of foodstuffs with BFRs is particularly important for a reliable risk assessment. For HBCDDs the recommended LOQ value is 0.01 µg/kg w.w. for α-, β- and γ-stereoisomers (Table 9). For total HBCDD measured by GC-MS, the corresponding LOQ value is 0.003 µg/kg (as cumulative response of all possible HBCDD diastereomers, Table 10).

Table 9: Recommended LOQs for PBDEs and HBCDDs from COMMISSION RECOMMENDATION of 3 March 2014 on the monitoring of traces of brominated flame retardants in food (2014/118/EU)

Food	Limit of quantification per congener/stereoisomer µg/kg (wet weight)
PBDEs	≤ 0.01
HBCDDs	0.01 ≤ 0.01

Table 10: Analytical recommendations from "Guidance document on analytical parameters for the determination of organobromine contaminants in food and feed" [3]

Food	Limit of quantification per congener/stereoisomer µg/kg (wet weight)
PBDEs	0.01 and 0.001 (all congeners except BDE-209)
HBCDDs	0.01 (sum of HBCDDs) and 0.003 (total HBCDD)

PBDEs:

The calculated assigned value for BDE-183 (0.00102 µg/kg) was in the range of the target LOQ for the test sample Fish Fillet (2501-FF). For BDE-28 the assigned value (0.0154 µg/kg) was in the range of the recommended LOQ of 0.01 µg/kg. For all other congeners assigned values were considerably above the recommended LOQ. For BDE-209 the calculated median value from 26 participants' reported values was 0.033 µg/kg product which is around 3 times higher than the recommended LOQ (Figure 4).

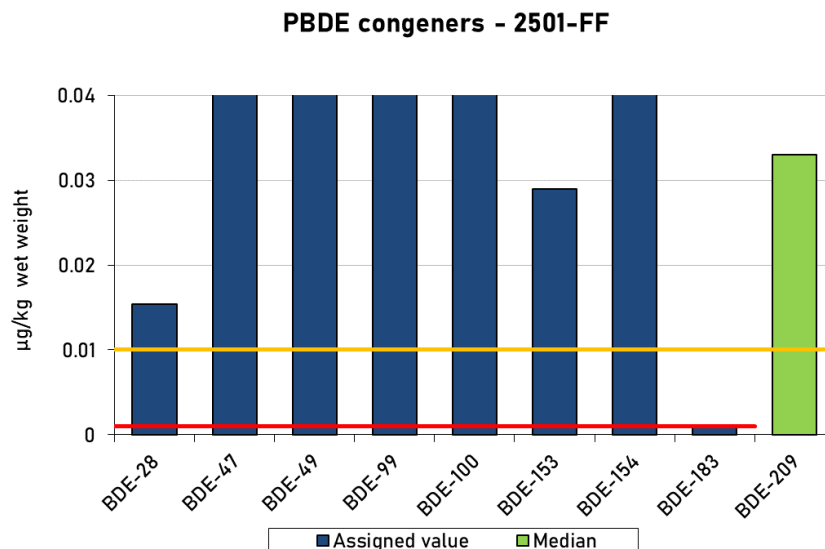


Figure 4: Comparison of assigned values for PBDE congeners with recommended LOQs (yellow line at 0.01 µg/kg wet weight and red line at 0.001 µg/kg wet weight) in Fish Fillet (2501-FF)

HBCDDs:

For beta- and gamma-HBCDD no assigned values could be calculated, because less than two-thirds of all reported results were above the LOQs (see calculation criteria section 4). Therefore, the median value was taken for comparison with the recommended LOQ. The median values for beta-HBCDD (0.01 µg/kg) and for gamma-HBCDD (0.01 µg/kg) were both at the recommended LOQ of 0.01 µg/kg fresh weight (see figure 5), showing that not all participating laboratories could reliably report results for beta- and gamma-HBCDDs in Fish Fillet at the recommended LOQ.

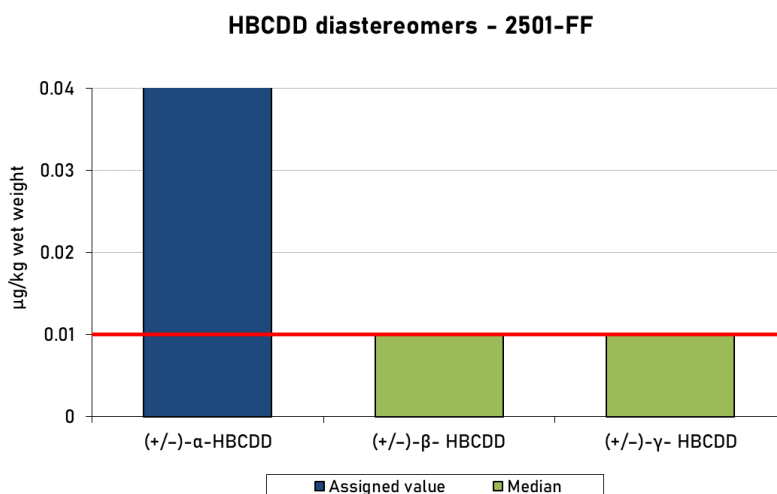


Figure 5: Comparison of assigned values for HBCDD stereoisomers with recommended LOQs (red line at 0.01 µg/kg product) in Fish Fillet (2501-FF)

5. Scoring of results – Z-scores

5.1. Z-scores calculation

Criteria for successful participation of laboratories were based on the evaluation of the results of individual congeners and sum parameters. For evaluation of results of physico-chemical methods the z-scores were calculated according to the following formula:

$$z = \frac{(x - x_a)}{\sigma_{prel} * x_a}$$

x : participant's result

x_a : assigned value

σ_{prel} : relative fitness-for-purpose-based "standard deviation for proficiency assessment"

For individual PBDE congeners, individual HBCDD diastereomers and PBDE and HBCDD sum parameters, the standard deviation for proficiency assessment σ_{prel} is defined as 20 %.

Z-scores for individual congeners / substances and diastereomers are only calculated and reported if levels for these congeners are equal to or above the LOQ. Otherwise, no z-scores will be given.

Interpretation of z-scores:

$|z\text{-score}| \leq 2$ satisfactory performance

$2 < |z\text{-score}| < 3$ questionable performance (warning signal)

$|z\text{-score}| \geq 3$ unsatisfactory performance (action signal)

5.2. PBDEs - Participants' z-scores

Table 11: Distribution of participants' z-scores for PBDEs for Fish Fillet (2501-FF)

Percentage of participants' results	$ z\text{-score} \leq 2$	$2 < z\text{-score} < 3$	$ z\text{-score} \geq 3$
BDE-28	92%	0%	8%
BDE-47	87%	10%	3%
BDE-49	83%	13%	4%
BDE-99	90%	0%	10%
BDE-100	84%	10%	6%
BDE-153	90%	7%	3%

Percentage of participants' results	$ z\text{-score} \leq 2$	$2 < z\text{-score} < 3$	$ z\text{-score} \geq 3$
BDE-154	84%	10%	6%
BDE-183	89%	6%	6%
Sum of 8 PBDEs without BDE-209 (ub)	83%	10%	7%
Sum of 8 PBDE including BDE-209 (lb)	86%	11%	4%
Sum of 9 PBDE including BDE-209 (lb)	84%	8%	8%
Sum of 9 PBDE including BDE-209 (lb)	84%	8%	8%

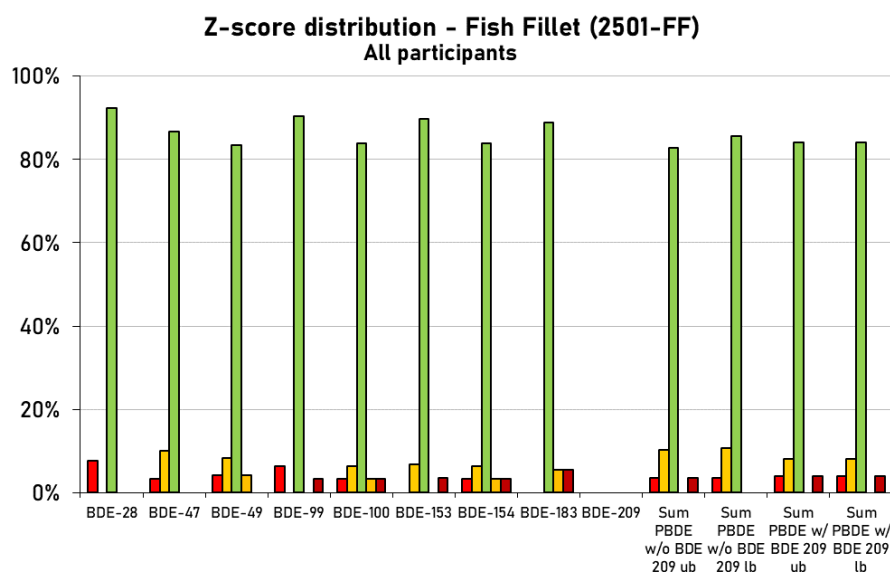


Figure 6: Distribution of participants' z-scores for PBDE congeners / sum parameters for Fish Fillet (2501-FF) [Green bars: $-2 \leq z\text{-score} \leq 2$, orange bars: $-3 < z\text{-score} < -2$, $2 < z\text{-score} < 3$, red bars: $z\text{-score} \leq -3$, $z\text{-score} \geq 3$]

5.3. HBCDDs - Participants' z-scores

HBCDD stereoisomers undergo thermal isomerization at temperatures above 160°C. With GC elution temperature of these compounds of normally above 160°C a separation of HBCDD stereoisomers using GC analysis is not possible. Only one unresolved peak is obtained. Additional thermal decomposition of HBCDDs is reported for temperatures above 240°C.

Therefore, in case of applying GC-MS methods for HBCDD analysis determination of total HBCDD (as sum of all originally present HBCDD diastereomers) is possible only.

Due to the low numbers of results for total HBCDD the sum of α -, β -, γ -HBCDD (using LC separation) was taken for comparison.

Table 12: Distribution of participants' z-scores for HBCDD for Fish Fillet (2501-FF)

Percentage of participants' results	$ z\text{-score} \leq 2$	$2 < z\text{-score} < 3$	$ z\text{-score} \geq 3$
(+/-)- α -HBCDD	83%	17%	-
Sum of α -, β -, γ -HBCDD (ub)	89%	11%	-
Sum of α -, β -, γ -HBCDD (lb)	83%	17%	-
Total HBCDD*	50%	50%	-

*Comparison of participants' results for total HBCDD with assigned value for sum of α -, β -, γ -HBCDD

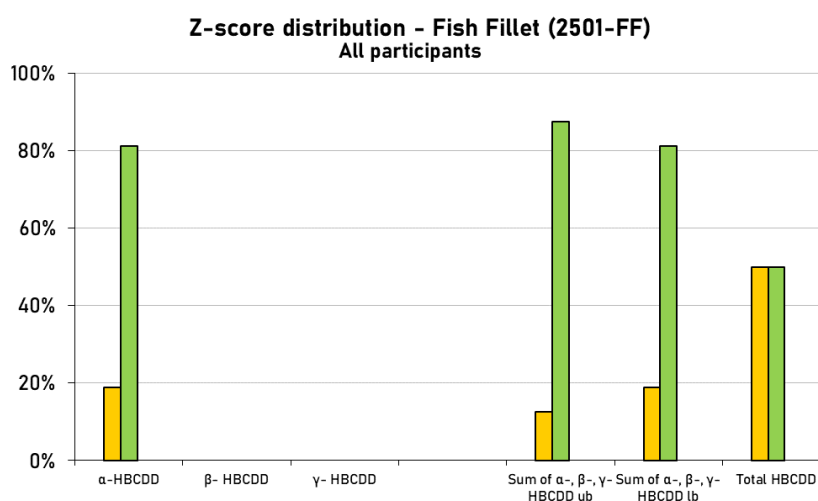


Figure 7: Distribution of participants' z-scores for HBCDD stereoisomers / sum parameters for Fish Fillet (2501-FF) [Green bars: $-2 \leq z\text{-score} \leq 2$, orange bars: $-3 < z\text{-score} < -2$, $2 < z\text{-score} < 3$, red bars: $z\text{-score} \leq -3$, $z\text{-score} \geq 3$]

6. Participants' feedback

A questionnaire for feedback from participants of this EURL proficiency test was available as online survey between 16 April 2025 and 30 May 2025. The survey was anonymous, but participants could also give their laboratory name. The identity of the laboratories is kept confidential. The survey included several questions related to different topics (participants' information, organization of the proficiency test, PT test samples and evaluation of results and summary of data) and a possibility to include comments and further suggestions. In total, 10 laboratories (13 % of all PT participants) replied to this survey.

Table 13: Participating laboratories in the feedback survey

Type of laboratory	Answers
National Reference Laboratory (NRL)	3
Official Laboratory (OFL)	6
Commercial laboratory	1
Other (e.g. research and development)	0
No Answer	0

General aspects

How satisfied are you with the organization of this proficiency test in general? Please rate the parts below according to your experience, with 0 stars meaning "no opinion" and 5 stars meaning "full satisfaction".

Announcement	
Instructions	
Sample shipment	
Reporting of results	
Preliminary report	

Specific aspects of this proficiency test

We would like to know a bit more about specific aspects of this proficiency test. Please rate the aspects below according to your experience, with 0 stars meaning "no opinion" and 5 stars meaning "full satisfaction".

Was all necessary information for participation and performance of the PT provided in an understandable way?	
Was the time frame acceptable?	
Was the handling of EUSurvey as webtool for reporting and source of instructions manageable?	
Was the evaluation of participant's results and the information in the preliminary report clear and comprehensible?	

Was the selected sample adequate for the goal to assess analytical performance of laboratories in relevant matrices?

Choice of matrix



Level of contamination



Comments (each from one lab):

- Levels of some analyte groups too low; EURL POPs: It was commercially available fish and not spiked to have a naturally contaminated sample. PCBs were in the appropriate range of the ML/AL.
- It would be very helpful if the assigned values and, where applicable, other relevant reference data were additionally provided in the form of an Excel file. This would greatly facilitate the evaluation and further processing of the results. EURL POPs: Unfortunately, Excel sheets are not compatible with accreditation requirements and quality control system.
- We suggest a publication organized by laboratory and not in tabular form; EURL POPs: Unfortunately, at the time being that is not an option to convert our assessment system and reporting system in that way
- Overall, it's an excellent PT. For its improvement, we suggest duplicate sample testing and repeatability calculation: EURL POPs: we do that in special interlaboratory studies for newer analyte groups but so far it is not planned for the proficiency tests
- Good work on getting the preliminary reports out so fast!

7. Quality control

The Deutsche Akkreditierungsstelle GmbH attests that the provider of proficiency testing Chemisches und Veterinäruntersuchungsamt Freiburg, EU Reference Laboratory (EURL) for halogenated persistent organic pollutants (POPs) in feed and food is competent under the terms of DIN EN ISO/IEC 17043:2010 to carry out proficiency testing in the testing field of determination of halogenated persistent organic pollutants (POPs) in food and feed (Accreditation number: D-EP-18625-01-00). Homogeneity and stability testing was performed under accreditation according to DIN EN ISO/IEC 17025:2018.

8. Results of participants

An overview of the PBDE and HBCDD results for the PT test sample Fish Fillet (2501-FF) are given in the following annexes. Laboratories are coded according to the laboratory codes sent after registration.

Complaints regarding the PT organisation, data evaluation and assessment of laboratories performance can be addressed directly to eurl-pops@cvuafr.bwl.de.

9. References

- [1] ISO 13528:2022, Statistical methods for use in proficiency testing by interlaboratory comparisons, International Organization for Standardization
- [2] M. Thompson, S.L.R. Ellison, R. Wood: The International Harmonized Protocol For The Proficiency Testing Of Analytical Chemistry Laboratories, Pure Appl. Chem., Vol. 78, No. 1, pp. 145-196, 2006.
- [3] EURL for halogenated POPs in feed and food (2021): Guidance Document on the Determination of Organobromine Contaminants - Analytical Parameters in food and feed, version 1.2 of 10 May 2023. Available online under <https://eurl-pops.eu/news/guidance-document-bcon-parameters>

10. Annex

Fish Fillet – 2501-FF	
1	Assigned and median values – PBDEs, HBCDDs and lipid content
2	Participants' results – Tables – PBDEs, HBCDDs and lipid content
3	Participants' z-scores – Tables – PBDEs, HBCDDs and lipid content
4	Participants' z-scores – Charts – PBDEs, HBCDDs
5	Homogeneity test – PBDEs
6	Overview participants' methods – Weighed sample, internal and recovery standards and comments
7	Overview participants' methods – Extractions, clean-up and detection
8	Overview participants' methods – Measurement uncertainty and Limit of Quantification

EURL for halogenated POPs in Feed and Food
c/o State Institute for Chemical and Veterinary Analysis of Food Freiburg



Coordinator: Alexander Schächtele
(head of EURL POPs)

Phone: +49 761 8855 500 E-Mail: eurl-pops@cvuafr.bwl.de



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

13 February 2026

Annex 1: Assigned values of PBDEs and HBCDDs

Test sample - Fish Fillet (2501-FF)

Assigned values of sum parameters and individual congeners

Estimation of the assigned value as the consensus of participants' results

Assigned value = Huber robust mean after exclusion of extreme outliers



EURL Proficiency Study on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP-2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

PBDE - Assigned values

Analyte		Result µg/kg wet weight	Assigned value [outliers removed]	Robust standard deviation [outliers removed]	Standard uncertainty [outliers removed]	No. of results contributing to assigned value	Median [all values]
BDE-28	2,2',4-tribromodiphenyl ether		0.0154	0.0026	0.00064	25	0.0160
BDE-47	2,2',4,4'-tetrabromodiphenyl ether		0.572	0.088	0.021	27	0.583
BDE-49	2,2',4,5'-tetrabromodiphenyl ether		0.0446	0.0077	0.0021	21	0.0449
BDE-99	2,2',4,4',5-pentabromodiphenyl ether		0.0584	0.010	0.0024	27	0.0604
BDE-100	2,2',4,4',6-pentabromodiphenyl ether		0.151	0.019	0.0046	27	0.158
BDE-153	2,2',4,4',5,5'-hexabromodiphenyl ether		0.0290	0.0042	0.0010	27	0.0302
BDE-154	2,2',4,4',5,6'-hexabromodiphenyl ether		0.0524	0.0067	0.0016	26	0.0536
BDE-183	2,2',3,4,4',5',6'-heptabromodiphenyl ether		0.00102	0.00028	0.000078	21	0.00111
BDE-209	2,2',3,3',4,4',5,5',6,6'-decabromodiphenyl ether						0.0330
Sum of 8 PBDE	without BDE-209 (ub)		0.917	0.13	0.032	25	0.957
Sum of 8 PBDE	without BDE-209 (lb)		0.928	0.12	0.029	24	0.955
Sum of 9 PBDE	including BDE-209 (ub)		0.959	0.18	0.048	22	1.00
Sum of 9 PBDE	including BDE-209 (lb)		0.950	0.13	0.036	20	0.973



EURL Proficiency Study on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP-2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

HBCDD - Assigned values

Analyte		Result µg/kg wet weight	Assigned value [outliers removed]	Robust standard deviation [outliers removed]	Standard uncertainty [outliers removed]	No. of results contributing to assigned value	Median [all values]
(+/-)- α -HBCDD	(1,2,5,6,9,10-hexabromo-(1R,2R,5S,6R,9R,10S)-rel-cyclododecane)		0.702	0.10	0.034	14	0.695
(+/-)- β - HBCDD	(1,2,5,6,9,10-hexabromo-(1R,2S,5R,6R,9R,10S)-rel-cyclododecane)						0.0100
(+/-)- γ - HBCDD	(1,2,5,6,9,10-hexabromo-(1R,2R,5R,6S,9S,10R)-rel-cyclododecane)						0.0100
Sum of α -, β -, γ -HBCDD	(ub)		0.740	0.13	0.043	14	0.727
Sum of α -, β -, γ -HBCDD	(lb)		0.702	0.10	0.034	14	0.695
Total HBCDD	(using GC-methods)						0.573



EURL Proficiency Study on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP-2501-FF]
EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)
Lipid content (BFR) - Assigned value

Analyte	Result %	Assigned value [outliers removed]	Robust standard deviation [outliers removed]	Standard uncertainty [outliers removed]	No. of results contributing to assigned value	Median [all values]
Lipid content		5.80	0.52	0.13	24	5.70



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

13 February 2026

Annex 2: Participants' results of PBDEs and HBCDDs

Test sample - Fish Fillet (2501-FF)

Fish Fillet (2501-FF)
PBDE - Results

LC	Sample	Result µg/kg wet weight	2,2',4'- tribromodiphenyl ether	2,2',4,4'- tetrabromodiphenyl ether	2,2',4,5'- tetrabromodiphenyl ether	2,2',4,4',5'- pentabromodiphenyl ether	2,2',4,4',6'- pentabromodiphenyl ether	2,2',4,4',5,5'- hexabromodiphenyl ether	2,2',4,4',5,6'- hexabromodiphenyl ether	2,2',3,4,4',5,6'- heptabromodiphenyl ether	2,2',3,3',4,4',5,5',6,6'- decabromodiphenyl ether		Sum of 8 PBDE without BDE-209 (ub)	Sum of 8 PBDE without BDE-209 (lb)	Sum of 9 PBDE including BDE-209 (ub)	Sum of 9 PBDE including BDE-209 (lb)
			BDE-28	BDE-47	BDE-49	BDE-99	BDE-100	BDE-153	BDE-154	BDE-183	BDE-209					
4	2501-FF		0.0041	0.111	0.00833	0.0134	0.0292	< 0.00544	0.00911	< 0.00907	< 0.181		0.19	0.175	0.371	0.175
5	2501-FF		0.0191	0.722	0.0494	0.0707	0.219	0.0356	0.0751	< 0.001	< 0.01		1.19	1.19	1.2	1.19
6	2501-FF		0.0163	0.643	0.0605	0.0647	0.159	0.0307	0.0251	0.00108	< 0.015		1	1	1.01	1
10	2501-FF		0.016	0.58	0.055	0.067	0.165	0.027	0.056	0.0013	0.0275		0.967	0.967	0.995	0.995
13	2501-FF		0.012	0.433	0.042	0.048	0.126	0.023	0.049	0.001	0.012		0.733	0.733	0.745	0.745
15	2501-FF		0.0159	0.61		0.0655	0.164	0.0334	0.0313	0.00109	< 0.033					
16	2501-FF		0.0149	0.597	0.0433	0.0585	0.16	0.0283	0.0564	< 0.0014	< 0.0134		0.959	0.957	0.972	0.957
17	2501-FF		0.00363	0.275	0.0218	0.039	0.0972	0.0302	0.0379	0.0172	0.183		0.522	0.522	0.704	0.704
19	2501-FF															
28	2501-FF		< 0.005	0.293	0.027	0.019	0.074	0.012	0.026	< 0.005	< 0.1		0.459	0.449	0.559	0.449
37	2501-FF		0.012	0.47	0.046	0.049	0.136	0.027	0.046	< 0.002	< 0.428		0.801	0.799	1.23	0.799
40	2501-FF		0.0205	0.626		0.0552	0.172	0.0319	0.0491	0.000648	2.98		0.955	0.955	3.94	3.94
41	2501-FF		0.0175	0.648	0.055	0.0668	0.14	0.0335	0.0536	0.000886			1.02	1.02		
42	2501-FF		0.018	0.71	0.046	0.064	0.18	0.034	0.056	< 0.0014	0.0081		1.1	1.1	1.1	1.1
44	2501-FF		0.0125	0.476	0.0404	0.0504	0.109	0.0227	0.0494	0.0007	< 0.022		0.761	0.761	0.783	0.761
45	2501-FF		< 0.01	0.28	< 0.01	0.04	0.08	0.016	0.046	< 0.01	< 0.01		0.492	0.462	0.502	0.462
48	2501-FF		< 0.03	0.565		0.061	0.147	< 0.03	0.062	< 0.03						
50	2501-FF		0.0153	0.562	0.0399	0.0544	0.145	0.0274	0.0495	0.000785	0.049		0.894	0.894	0.943	0.943
51	2501-FF		0.0124	0.581	0.0448	0.0604	0.161	0.0292	0.0494	0.000726	0.107		0.939	0.939	1.05	1.05
57	2501-FF		0.0154	0.597		0.0644	0.166	0.0279	0.0559	0.000996	0.00892		0.927	0.927	0.936	0.936
58	2501-FF															
59	2501-FF		0.016	0.508	0.034	0.053	0.149	0.024	0.048	< 0.01	0.034		0.842	0.832	0.876	0.866
63	2501-FF		0.0175	0.573	0.0679	0.0784	0.157	0.0334	0.0563	0.0015			0.985	0.985		
65	2501-FF		0.017	0.643	0.049	0.063	0.168	0.033	0.055	0.001	0.011		1.03	1.03	1.04	1.04
69	2501-FF		0.0162	0.619	0.0432	0.0578	0.158	0.0306	0.0576	< 0.00274			0.985	0.983		
70	2501-FF		< 0.32	< 0.32		21.4	56.6	7.76	18.5	< 0.32						
71	2501-FF		0.012	0.421	0.0248	0.0428	0.105	0.0204	0.043	0.000808	0.537		0.67	0.67	1.21	1.21
72	2501-FF		0.016	0.637	0.0529	0.0497	0.163	0.0259	0.057	0.00111	< 0.05		1	1	1.05	1
74	2501-FF		< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9			7.2			
75	2501-FF		0.0164	0.609	0.0453	0.0743	0.164	0.0326	0.0607	< 0.001	< 0.05		1	1	1.05	1
77	2501-FF															
80	2501-FF		0.015	0.583	0.045	0.06	0.154	0.031	0.05	0.001	0.012		0.939	0.939	0.951	0.951
86	2501-FF		0.019	0.66	0.042	0.068	0.15	0.031	0.058	0.0013	< 0.12		1	1	1.1	1
90	2501-FF		0.0152	0.614	0.0459	0.0607	0.161	0.0308	0.0607	0.000694	< 0.033		0.989	0.989	1.02	0.989
75A	2501-FF		< 0.05	0.732	< 0.07	0.066	0.171	0.031	0.056	< 0.002	< 0.01		1.18	1.06	1.19	1.06

Fish Fillet (2501-FF)
HBCDD - Results

LC	Sample	Result µg/kg wet weight	(+/-)-α-HBCDD	(+/-)-β- HBCDD	(+/-)-γ- HBCDD	Sum of α-, β-, γ-HBCDD (ub)	Sum of α-, β-, γ-HBCDD (lb)	Total HBCDD (using GC-methods)
			1,2,5,6,9,10-hexabromo-(1R,2R,5S,6R,9R,10S)- rel-cyclododecane	1,2,5,6,9,10-hexabromo-(1R,2S,5R,6R,9R,10S)- rel-cyclododecane	1,2,5,6,9,10-hexabromo-(1R,2R,5R,6S,9S,10R)- rel-cyclododecane			
4	2501-FF		0.32	< 0.006	< 0.006	0.332	0.32	0.738
5	2501-FF							
6	2501-FF		0.917	< 0.002	0.002	0.921	0.919	
9	2501-FF		0.684	< 0.2	< 0.02	0.744	0.684	
10	2501-FF		0.802	< 0.01	< 0.01	0.822	0.802	
13	2501-FF		0.37	< 0.05	< 0.05	0.47	0.37	
15	2501-FF							
16	2501-FF		0.572	< 0.005	< 0.005	0.582	0.572	
17	2501-FF							
19	2501-FF		0.796	< 0.1	< 0.1	0.996	0.796	
28	2501-FF		0.327	< 0.01	< 0.01	0.347	0.327	
37	2501-FF		0.586	< 0.01	< 0.01	0.606	0.586	
40	2501-FF							
41	2501-FF							
42	2501-FF		0.69	< 0.04	< 0.04	0.77	0.69	
44	2501-FF							
45	2501-FF							
48	2501-FF							
50	2501-FF							
51	2501-FF		0.711	< 0.001	< 0.001	0.713	0.711	
57	2501-FF							
58	2501-FF		0.7	< 0.03	< 0.03	0.76	0.7	
59	2501-FF		0.72	< 0.01	< 0.01	0.74	0.72	
63	2501-FF							
65	2501-FF							
69	2501-FF		0.745	< 0.02	< 0.02	0.785	0.745	
70	2501-FF							
71	2501-FF							0.407
72	2501-FF		0.762	< 0.01	< 0.01	0.782	0.762	
74	2501-FF							
75	2501-FF		0.69	< 0.01	< 0.01	0.71	0.69	
77	2501-FF		0.644	< 0.02	< 0.02	0.684	0.644	
80	2501-FF							
86	2501-FF							
90	2501-FF							
75A	2501-FF		0.793	< 0.01	< 0.01	0.813	0.793	



EURL Proficiency Study on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP-2501-FF]
EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)
Lipid content - Results

LC	Sample	Result %	Lipid content	Lipid content	Lipid content
			PBDE	HBCDD	Mean
4	2501-FF				
5	2501-FF		9.0		9.0
6	2501-FF		6.4	6.4	6.4
10	2501-FF		5.7	5.7	5.7
13	2501-FF		4.9	5.7	5.3
15	2501-FF		5.7	5.7	5.7
16	2501-FF		5.5	5.4	5.4
17	2501-FF		5.4		5.4
19	2501-FF			6.8	6.8
28	2501-FF				
37	2501-FF		5.6	5.6	5.6
40	2501-FF		6.1		6.1
41	2501-FF		6.7		6.7
42	2501-FF		6.3	6.3	6.3
44	2501-FF				
45	2501-FF				
48	2501-FF				
50	2501-FF		5.5		5.5
51	2501-FF		6.2	6.2	6.2
57	2501-FF		5.4		5.4
58	2501-FF			3.2	3.2
59	2501-FF				
63	2501-FF		5.9		5.9
65	2501-FF		5.6		5.6
69	2501-FF		6.3	6.3	6.3
70	2501-FF				
71	2501-FF		4.0	4.0	4
72	2501-FF		5.6	6.1	5.8
74	2501-FF				
75	2501-FF		6.1	6.1	6.1
77	2501-FF			6.3	6.3
80	2501-FF		5.6		5.6
86	2501-FF				
90	2501-FF		5.5		5.5
75A	2501-FF		6.1	6.1	6.1



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

13 February 2026

Annex 3: Participants' z-scores of PBDEs and HBCDDs - Tables

Test sample - Fish Fillet (2501-FF)

Z-scores of sum parameters and individual results

Calculation of z-score on basis of assigned value

$$z = (x - x_a) / x_a \cdot \sigma_{\text{prel}}$$

x_a : assigned value

x : participant's result

σ_{prel} : fitness-for-purpose-based relative standard deviation for proficiency assessment

20%: Evaluated individual PBDE congeners and HBCDD diastereomers and sum

Fish Fillet (2501-FF)

PBDE - Z-scores

LC	Sample	Z-score [σ _p = 20 %]	2,2',4- tribromodiphenyl ether	2,2',4,4'- tetrabromodiphenyl ether	2,2',4,5'- tetrabromodiphenyl ether	2,2',4,4',5'- pentabromodiphenyl ether	2,2',4,4',6'- pentabromodiphenyl ether	2,2',4,4',5,5'- hexabromodiphenyl ether	2,2',4,4',5,6'- hexabromodiphenyl ether	2,2',3,4,4',5',6- heptabromodiphenyl ether	2,2',3,3',4,4',5,5',6,6'- decabromodiphenyl ether	Sum of 8 PBDE without BDE-209 (ub)	Sum of 8 PBDE without BDE-209 (lb)	Sum of 9 PBDE including BDE-209 (ub)	Sum of 9 PBDE including BDE-209 (lb)
			BDE-28	BDE-47	BDE-49	BDE-99	BDE-100	BDE-153	BDE-154	BDE-183	BDE-209				
4	2501-FF		-3.7	-4.0	-4.1	-3.9	-4.0		-4.1			-4.0	-4.1	-3.1	-4.1
5	2501-FF		1.2	1.3	0.5	1.1	2.3	1.1	2.2			1.5	1.4	1.3	1.3
6	2501-FF		0.3	0.6	1.8	0.5	0.3	0.3	-2.6	0.3		0.5	0.4	0.3	0.3
10	2501-FF		0.2	0.1	1.2	0.7	0.5	-0.3	0.3	1.4		0.3	0.2	0.2	0.2
13	2501-FF		-1.1	-1.2	-0.3	-0.9	-0.8	-1.0	-0.3	-0.1		-1.0	-1.1	-1.1	-1.1
15	2501-FF		0.2	0.3		0.6	0.4	0.8	-2.0	0.3					
16	2501-FF		-0.2	0.2	-0.1	0.0	0.3	-0.1	0.4			0.2	0.2	0.1	0.0
17	2501-FF		-3.8	-2.6	-2.6	-1.7	-1.8	0.2	-1.4	79.3		-2.2	-2.2	-1.3	-1.3
19	2501-FF														
28	2501-FF			-2.4	-2.0	-3.4	-2.5	-2.9	-2.5			-2.5	-2.6	-2.1	-2.6
37	2501-FF		-1.1	-0.9	0.2	-0.8	-0.5	-0.3	-0.6			-0.6	-0.7	1.4	-0.8
40	2501-FF		1.7	0.5		-0.3	0.7	0.5	-0.3	-1.8		0.2	0.1	15.5	15.7
41	2501-FF		0.7	0.7	1.2	0.7	-0.4	0.8	0.1	-0.7		0.6	0.5		
42	2501-FF		0.8	1.2	0.2	0.5	1.0	0.9	0.3			1.0	0.9	0.7	0.8
44	2501-FF		-0.9	-0.8	-0.5	-0.7	-1.4	-1.1	-0.3	-1.6		-0.9	-0.9	-0.9	-1.0
45	2501-FF			-2.6		-1.6	-2.4	-2.2	-0.6			-2.3	-2.5	-2.4	-2.6
48	2501-FF			-0.1		0.2	-0.1		0.9						
50	2501-FF		0.0	-0.1	-0.5	-0.3	-0.2	-0.3	-0.3	-1.2		-0.1	-0.2	-0.1	0.0
51	2501-FF		-1.0	0.1	0.0	0.2	0.3	0.0	-0.3	-1.4		0.1	0.1	0.5	0.5
57	2501-FF		0.0	0.2		0.5	0.5	-0.2	0.3	-0.1		0.1	0.0	-0.1	-0.1
58	2501-FF														
59	2501-FF		0.2	-0.6	-1.2	-0.5	-0.1	-0.9	-0.4			-0.4	-0.5	-0.4	-0.4
63	2501-FF		0.7	0.0	2.6	1.7	0.2	0.8	0.4	2.4		0.4	0.3		
65	2501-FF		0.5	0.6	0.5	0.4	0.6	0.7	0.2	-0.1		0.6	0.5	0.4	0.5
69	2501-FF		0.3	0.4	-0.2	-0.1	0.2	0.3	0.5			0.4	0.3		
70	2501-FF					1827.2	1869.2	1332.9	1760.3						
71	2501-FF		-1.1	-1.3	-2.2	-1.3	-1.5	-1.5	-0.9	-1.0		-1.3	-1.4	1.3	1.4
72	2501-FF		0.2	0.6	0.9	-0.7	0.4	-0.5	0.4	0.4		0.5	0.4	0.5	0.3
74	2501-FF											34.3			
75	2501-FF		0.3	0.3	0.1	1.4	0.4	0.6	0.8			0.5	0.4	0.5	0.3
77	2501-FF														
80	2501-FF		-0.1	0.1	0.0	0.1	0.1	0.3	-0.2	-0.1		0.1	0.1	0.0	0.0
86	2501-FF		1.2	0.8	-0.3	0.8	0.0	0.3	0.5	1.4		0.5	0.4	0.7	0.3
90	2501-FF		-0.1	0.4	0.1	0.2	0.3	0.3	0.8	-1.6		0.4	0.3	0.3	0.2
75A	2501-FF			1.4		0.7	0.7	0.3	0.3			1.4	0.7	1.2	0.6

Fish Fillet (2501-FF)
HBCDD - Z-scores

LC	Sample	Z-score [σ _p = 20 %]	(+/-)-α-HBCDD 1,2,5,6,9,10-hexabromo-(1R,2R,5S,6R,9R,10S)- rel-cyclododecane	(+/-)-β- HBCDD 1,2,5,6,9,10-hexabromo-(1R,2S,5R,6R,9R,10S)- rel-cyclododecane	(+/-)-γ- HBCDD 1,2,5,6,9,10-hexabromo-(1R,2R,5R,6S,9S,10R)- rel-cyclododecane	Sum of α-, β-, γ-HBCDD (ub)	Sum of α-, β-, γ-HBCDD (lb)	Total HBCDD* (using GC-methods)
4	2501-FF		-2.7			-2.8	-2.7	
5	2501-FF							
6	2501-FF		1.5			1.2	1.5	
9	2501-FF		-0.1			0.0	-0.1	
10	2501-FF		0.7			0.6	0.7	
13	2501-FF		-2.4			-1.8	-2.4	
15	2501-FF							0.3
16	2501-FF		-0.9			-1.1	-0.9	
17	2501-FF							
19	2501-FF		0.7			1.7	0.7	
28	2501-FF		-2.7			-2.7	-2.7	
37	2501-FF		-0.8			-0.9	-0.8	
40	2501-FF							
41	2501-FF							
42	2501-FF		-0.1			0.2	-0.1	
44	2501-FF							
45	2501-FF							
48	2501-FF							
50	2501-FF							
51	2501-FF		0.1			-0.2	0.1	
57	2501-FF							
58	2501-FF		0.0			0.1	0.0	
59	2501-FF		0.1			0.0	0.1	
63	2501-FF							
65	2501-FF							
69	2501-FF		0.3			0.3	0.3	
70	2501-FF							
71	2501-FF							-2.1
72	2501-FF		0.4			0.3	0.4	
74	2501-FF							
75	2501-FF		-0.1			-0.2	-0.1	
77	2501-FF		-0.4			-0.4	-0.4	
80	2501-FF							
86	2501-FF							
90	2501-FF							
75A	2501-FF		0.6					

* Z-scores for information only; calculation based on assigned value for sum of α-, β-, γ-HBCDD (lb)

Fish Fillet (2501-FF)
Lipid content - Z-scores

LC	Sample	Z-score [σ _p = 10 %]	Lipid content	Lipid content	Lipid content
			PBDE	HBCDD	Mean
4	2501-FF				
5	2501-FF		5.4		5.4
6	2501-FF		1.0	1.0	1.0
10	2501-FF		-0.2	-0.2	-0.2
13	2501-FF		-1.6	-0.2	-0.9
15	2501-FF		-0.2	-0.2	-0.2
16	2501-FF		-0.6	-0.7	-0.6
17	2501-FF		-0.7		-0.7
19	2501-FF			1.7	1.7
28	2501-FF				
37	2501-FF		-0.4	-0.4	-0.4
40	2501-FF		0.5		0.5
41	2501-FF		1.5		1.5
42	2501-FF		0.8	0.8	0.8
44	2501-FF				
45	2501-FF				
48	2501-FF				
50	2501-FF		-0.5		-0.5
51	2501-FF		0.7	0.7	0.7
57	2501-FF		-0.7		-0.7
58	2501-FF			-4.4	-4.4
59	2501-FF				
63	2501-FF		0.2		0.2
65	2501-FF		-0.3		-0.3
69	2501-FF		0.9	0.9	0.9
70	2501-FF				
71	2501-FF		-3.1	-3.1	-3.1
72	2501-FF		-0.4	0.4	0.0
74	2501-FF				
75	2501-FF		0.5	0.5	0.5
77	2501-FF			0.9	0.9
80	2501-FF		-0.3		-0.3
86	2501-FF				
90	2501-FF		-0.5		-0.5
75A	2501-FF		0.5	0.5	0.5



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

13 February 2026

Annex 4: Participants' z-scores of PBDEs and HBCDDs - Charts

Test sample - Fish Fillet (2501-FF)

Z-scores of sum parameters and individual results

Calculation of z-score on basis of assigned value

$$z = (x - x_a) / x_a \cdot \sigma_{\text{prel}}$$

x_a : assigned value

x : participant's result

σ_{prel} : fitness-for-purpose-based relative standard deviation for proficiency assessment

20%: Evaluated individual PBDE congeners and HBCDD diastereomers and sum

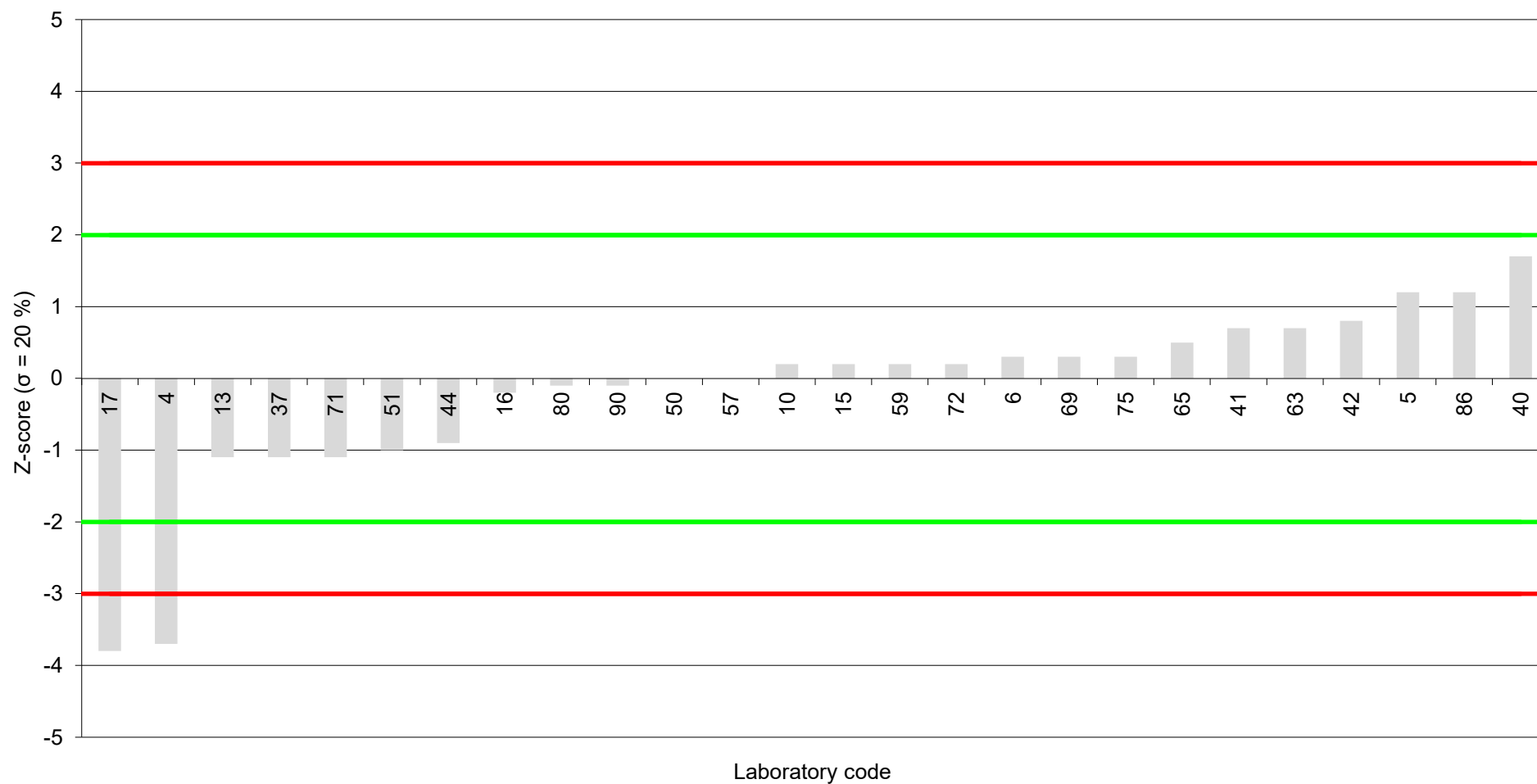
± 2 z-scores: ———

± 3 z-scores: ———

Fish Fillet (2501-FF)

BDE-28

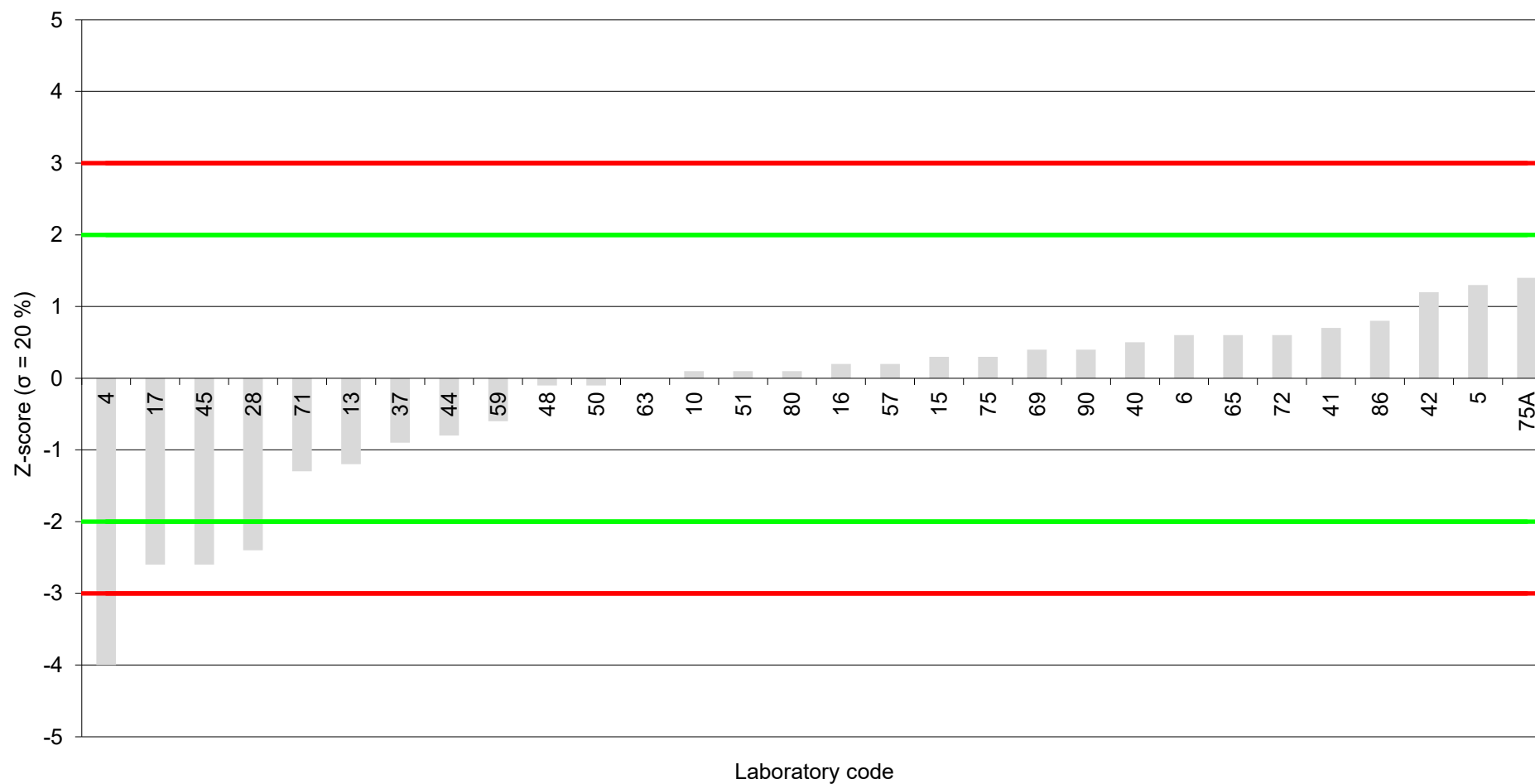
Assigned value: 0.0154 µg/kg wet weight



Fish Fillet (2501-FF)

BDE-47

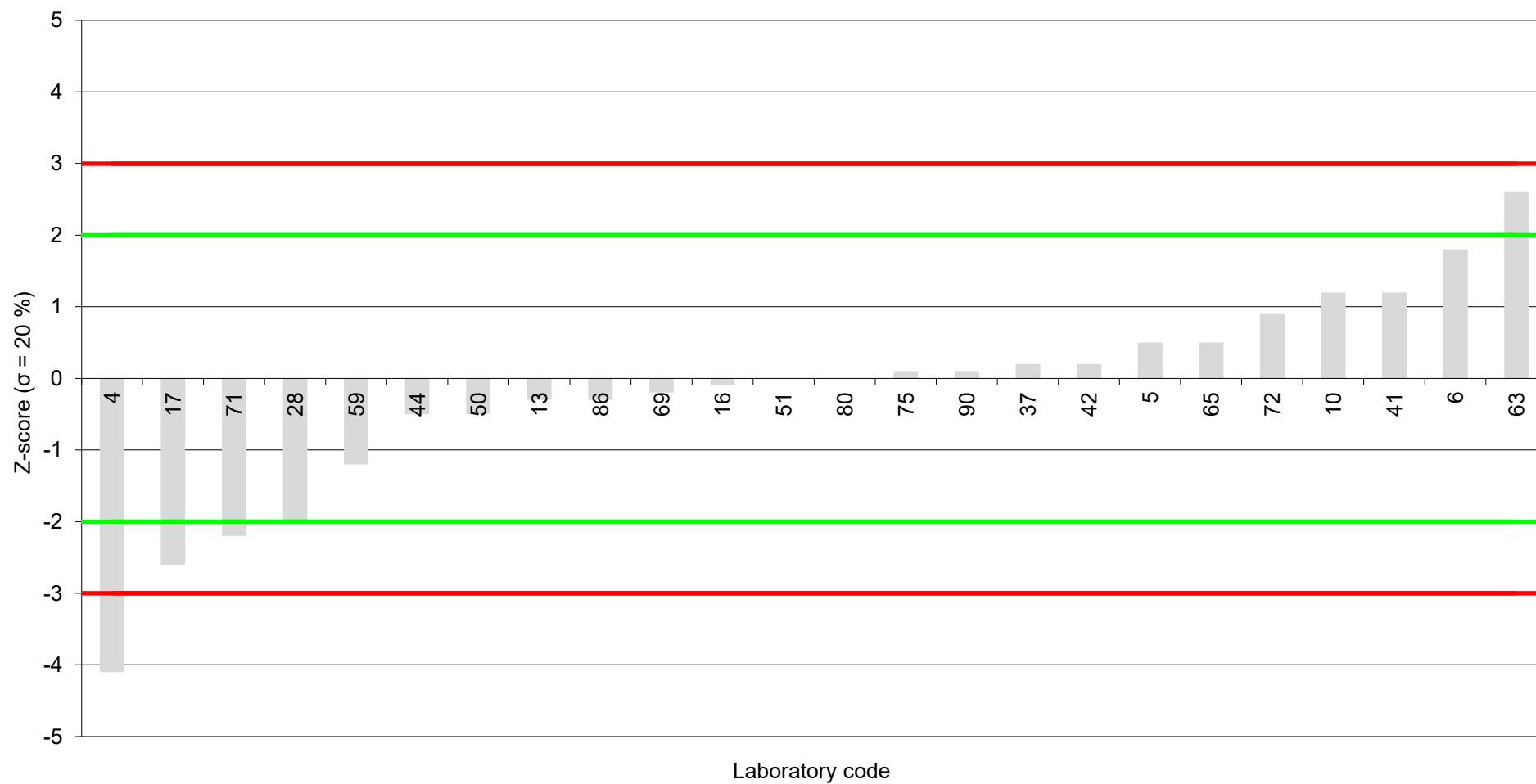
Assigned value: 0.572 µg/kg wet weight



Fish Fillet (2501-FF)

BDE-49

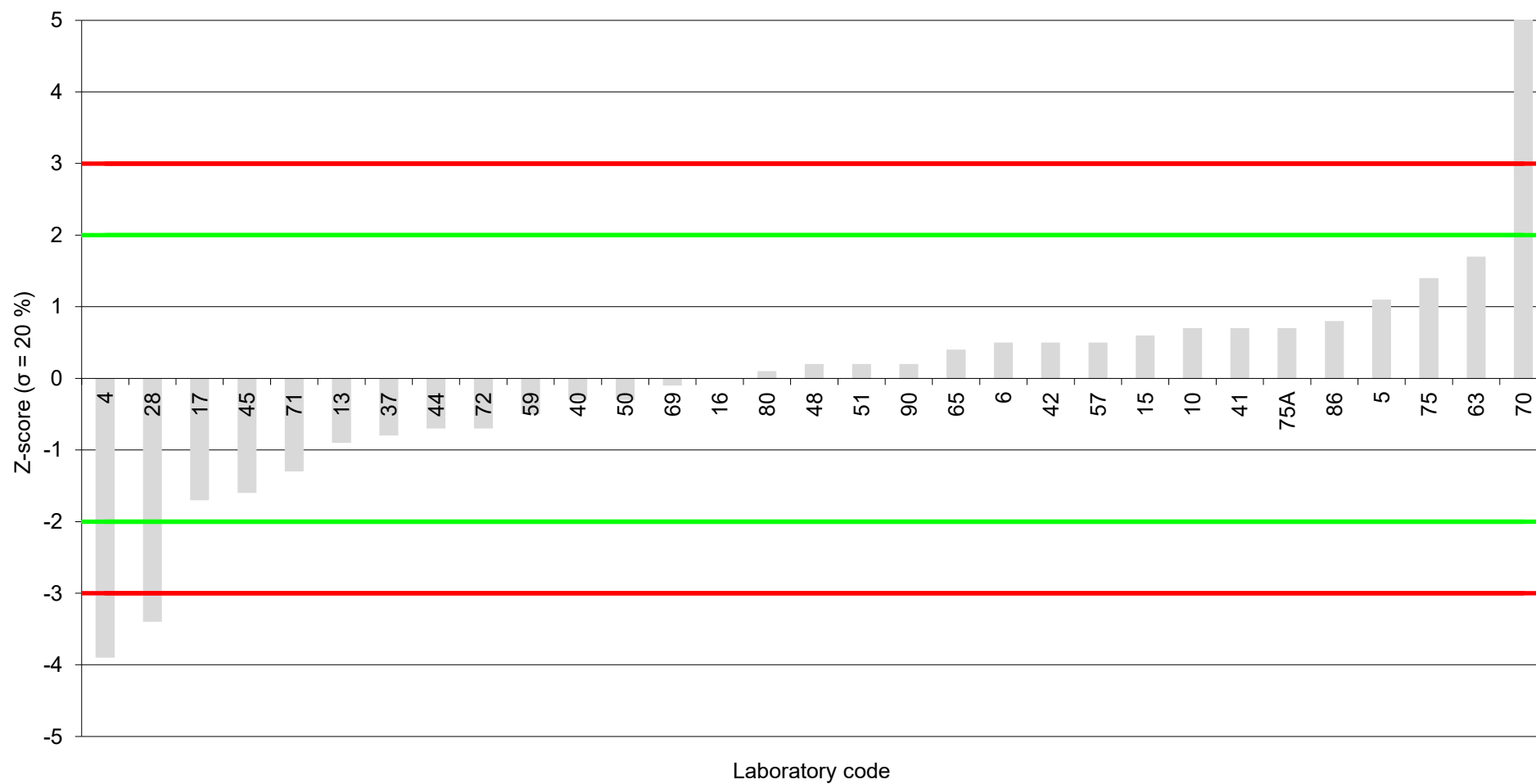
Assigned value: 0.0446 µg/kg wet weight



Fish Fillet (2501-FF)

BDE-99

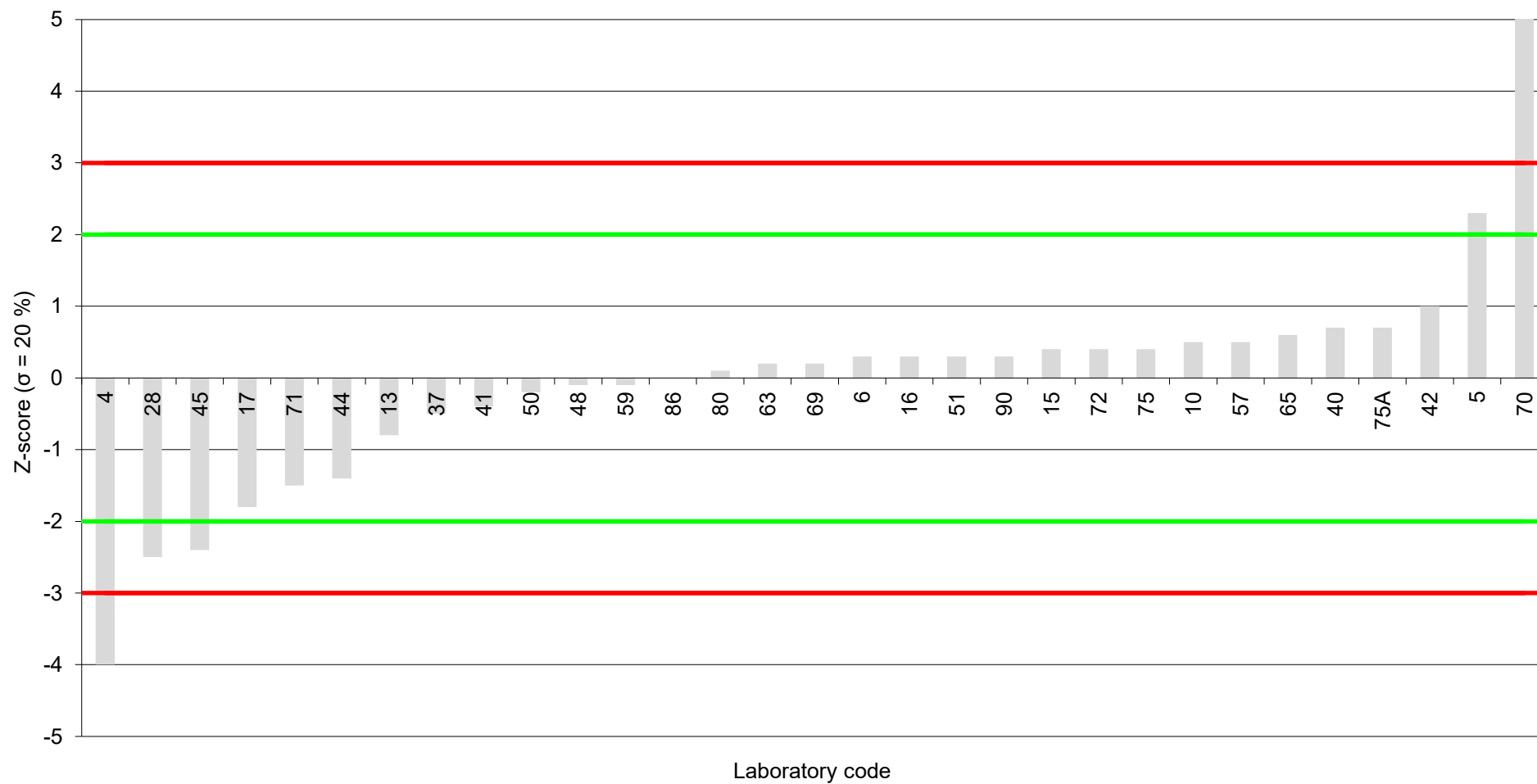
Assigned value: 0.0584 µg/kg wet weight



Fish Fillet (2501-FF)

BDE-100

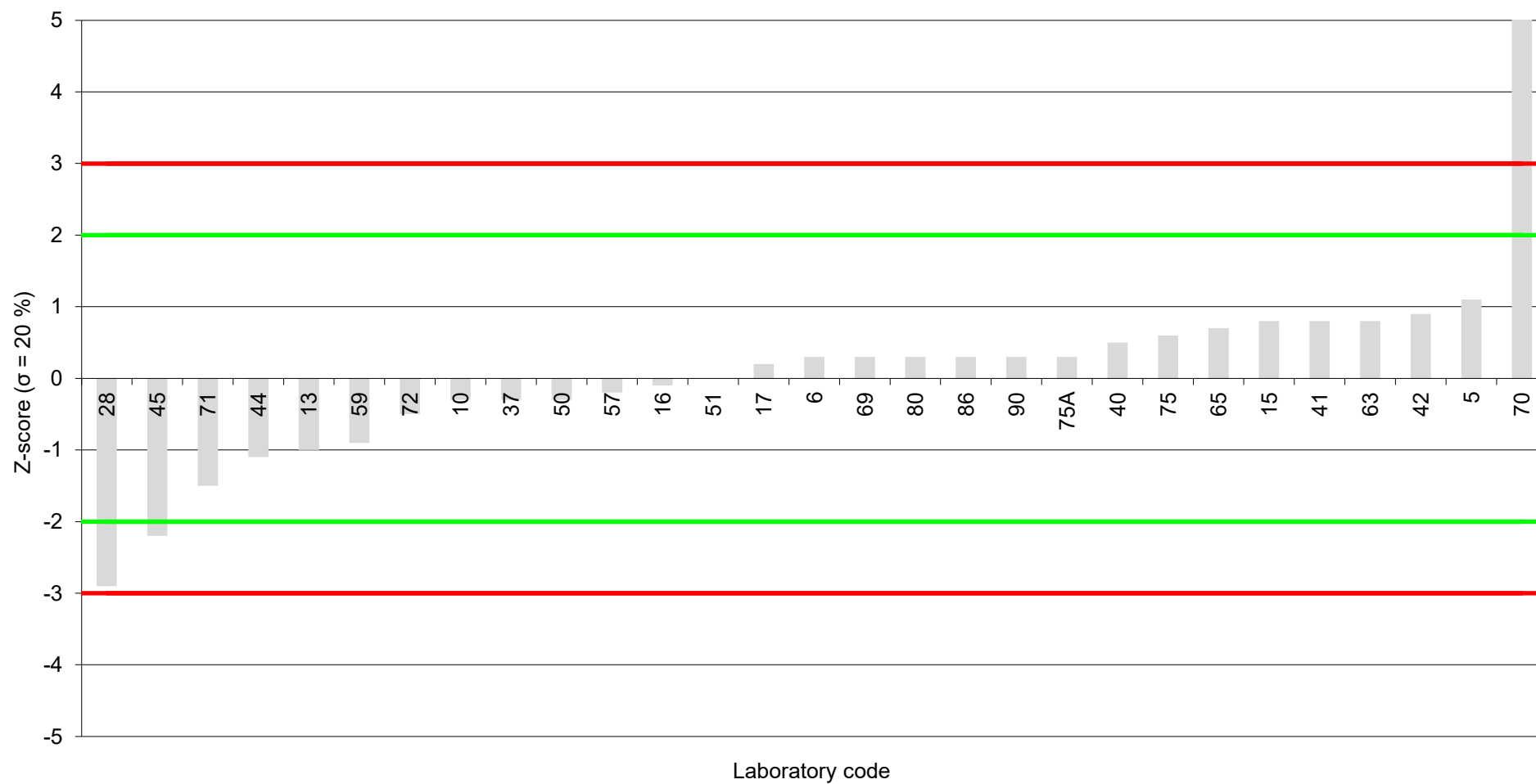
Assigned value: 0.151 µg/kg wet weight



Fish Fillet (2501-FF)

BDE-153

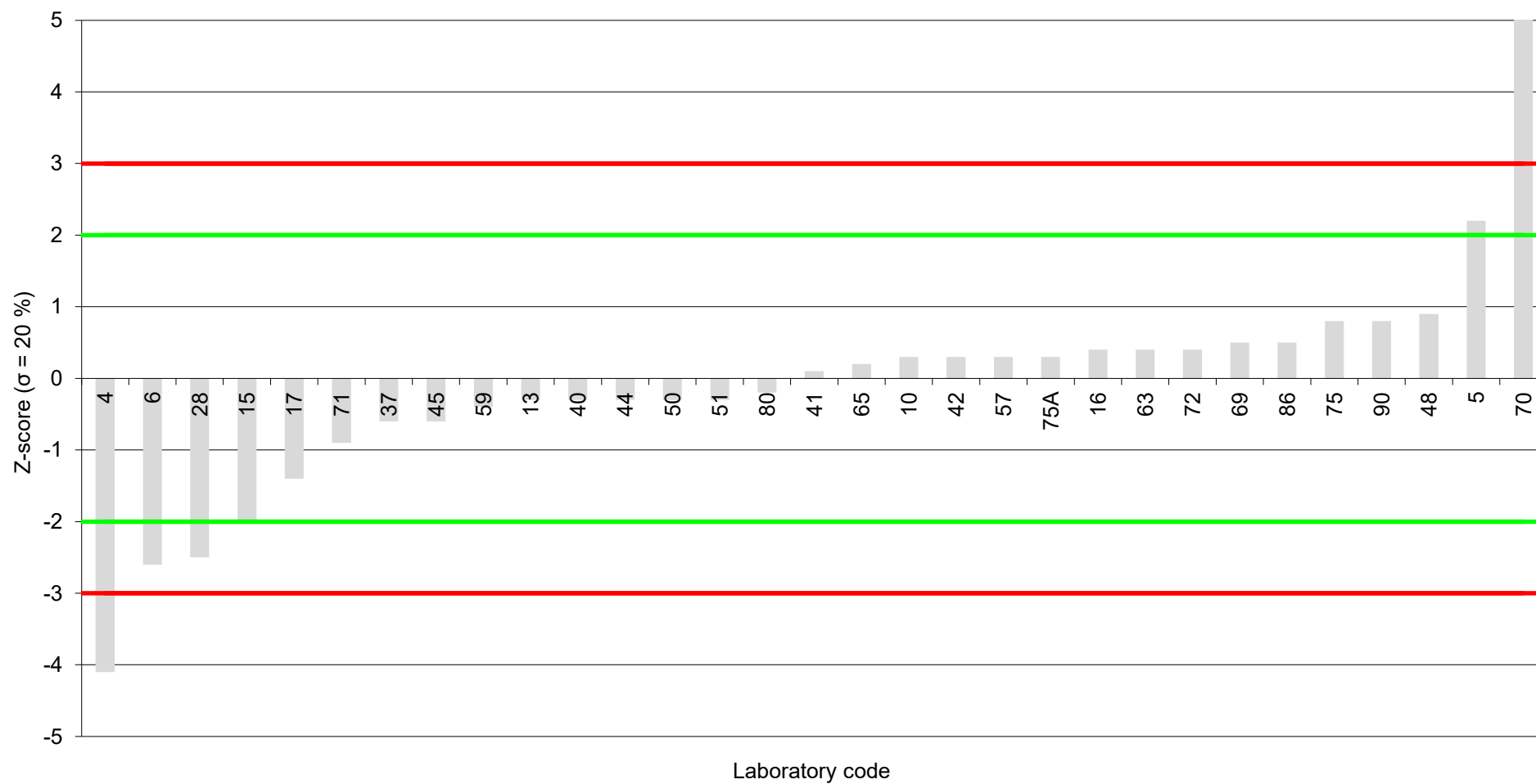
Assigned value: 0.029 µg/kg wet weight



Fish Fillet (2501-FF)

BDE-154

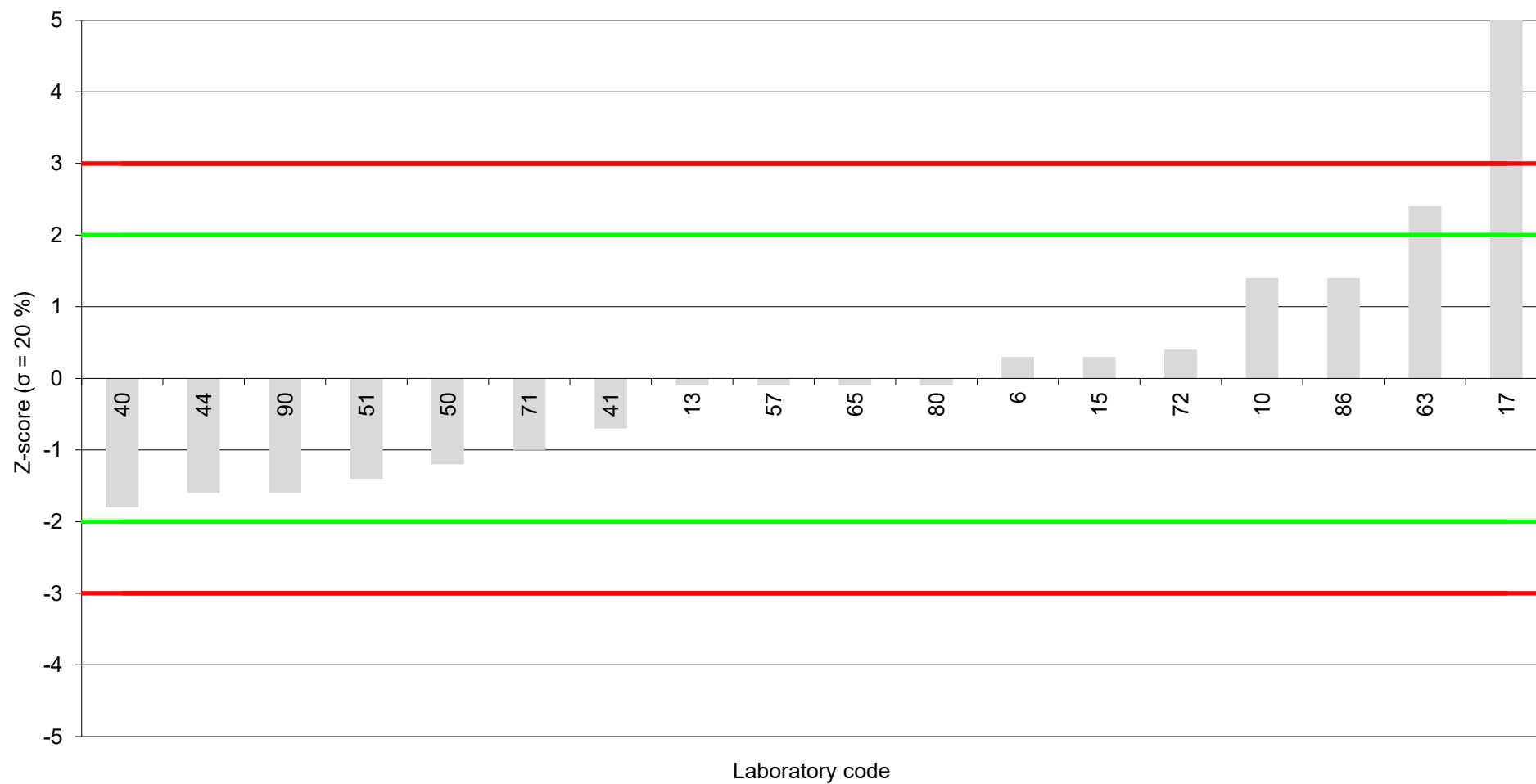
Assigned value: 0.0524 µg/kg wet weight



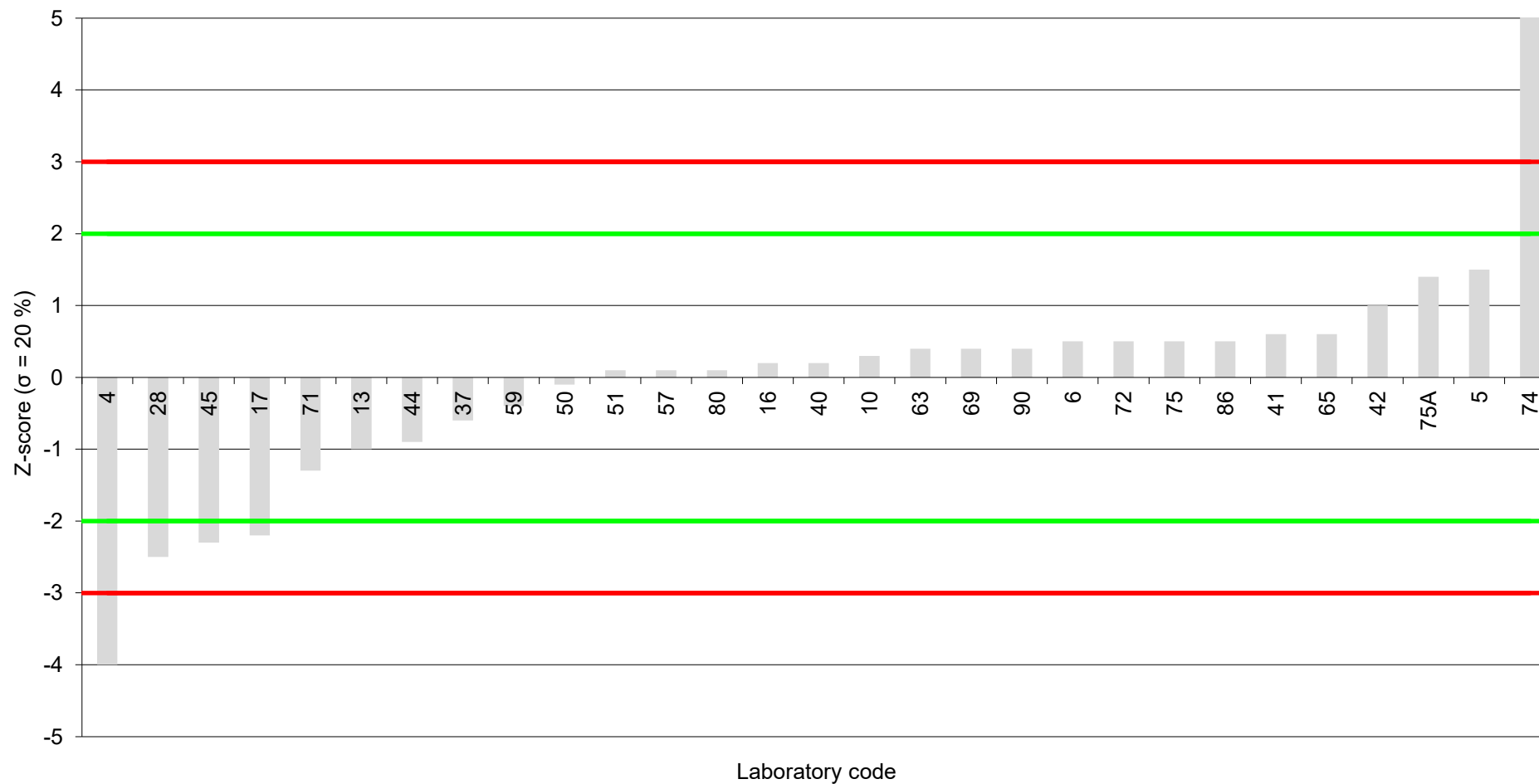
Fish Fillet (2501-FF)

BDE-183

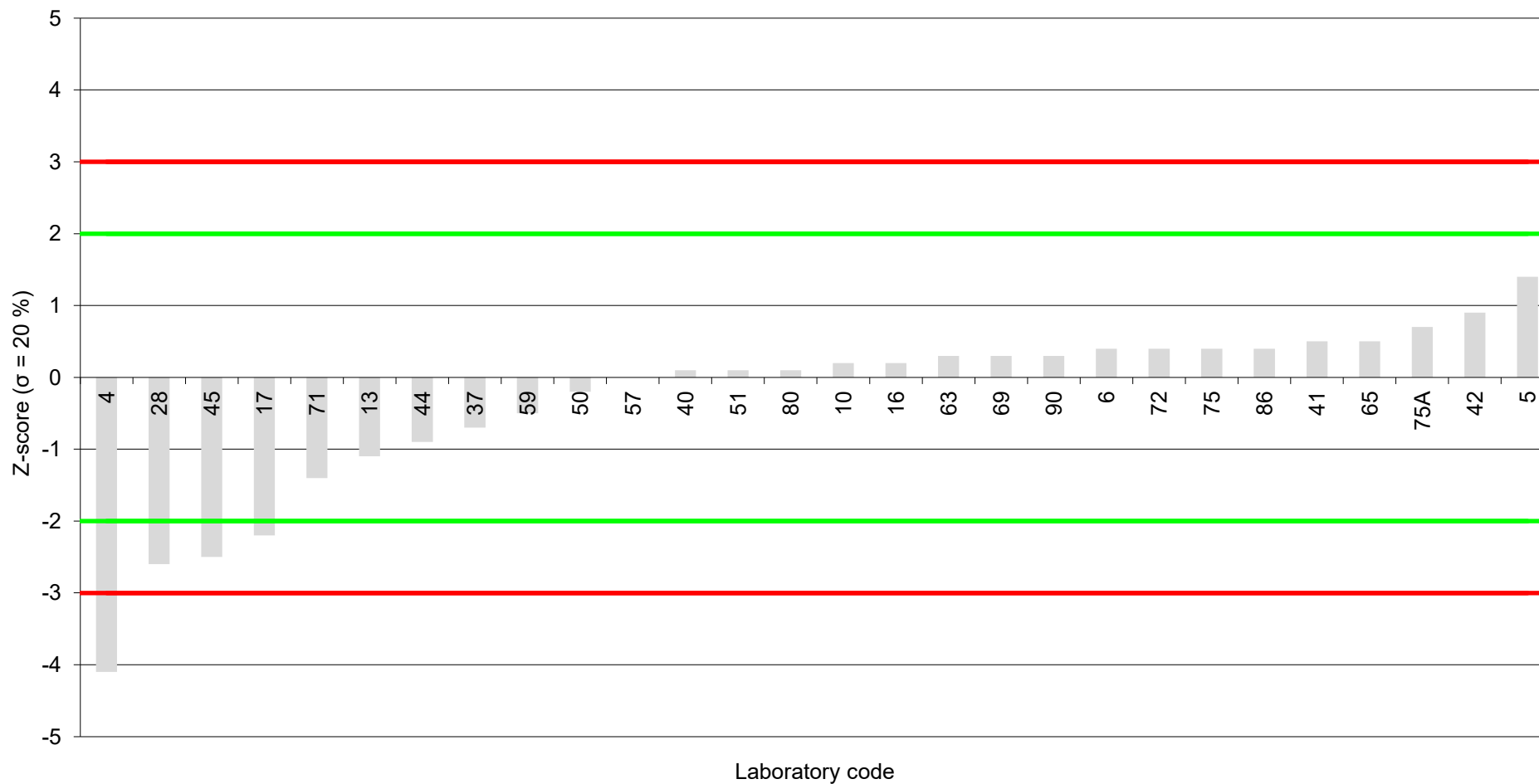
Assigned value: 0.00102 µg/kg wet weight



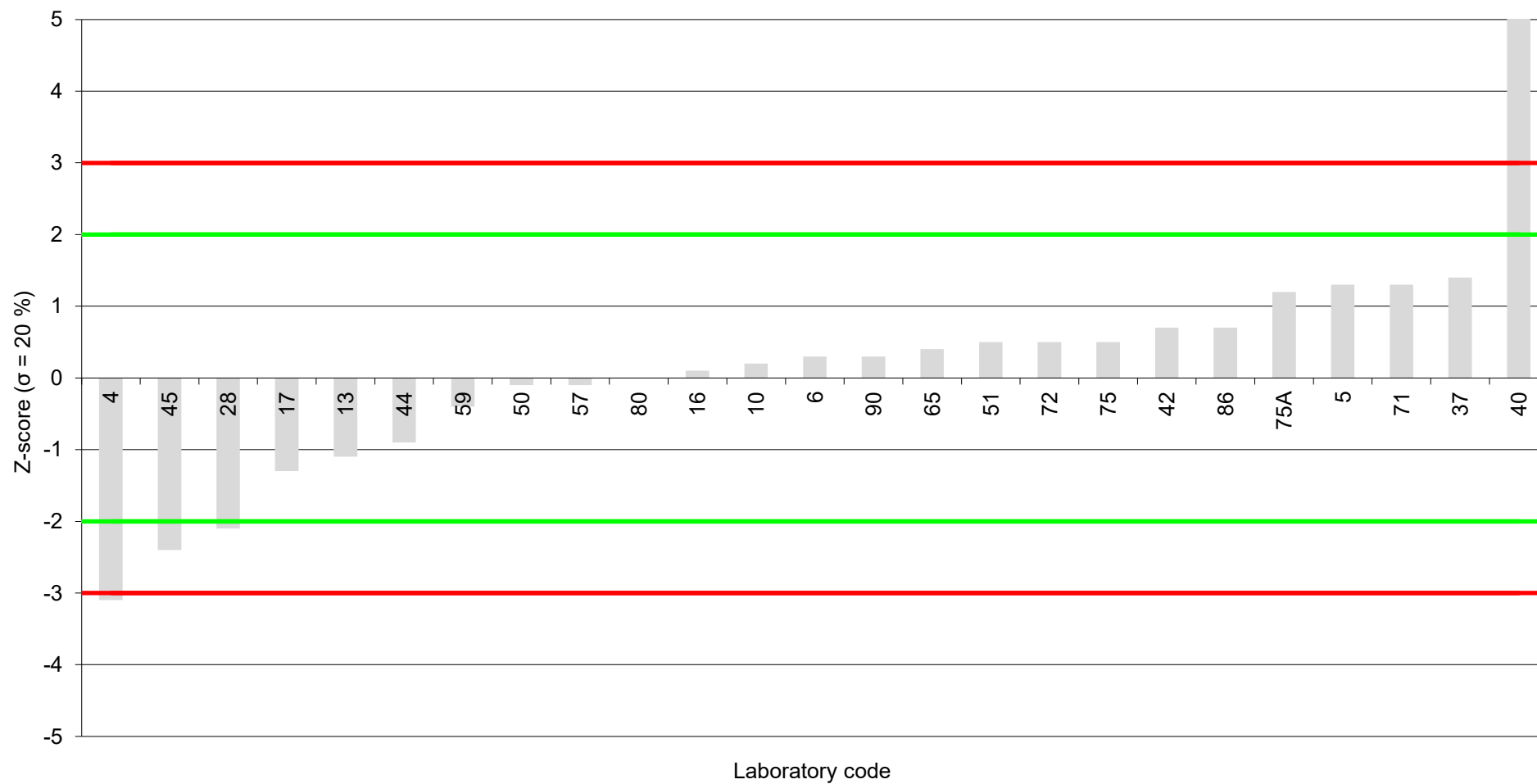
Fish Fillet (2501-FF)
Sum of PBDE without BDE-209 ub
Assigned value: 0.917 µg/kg wet weight



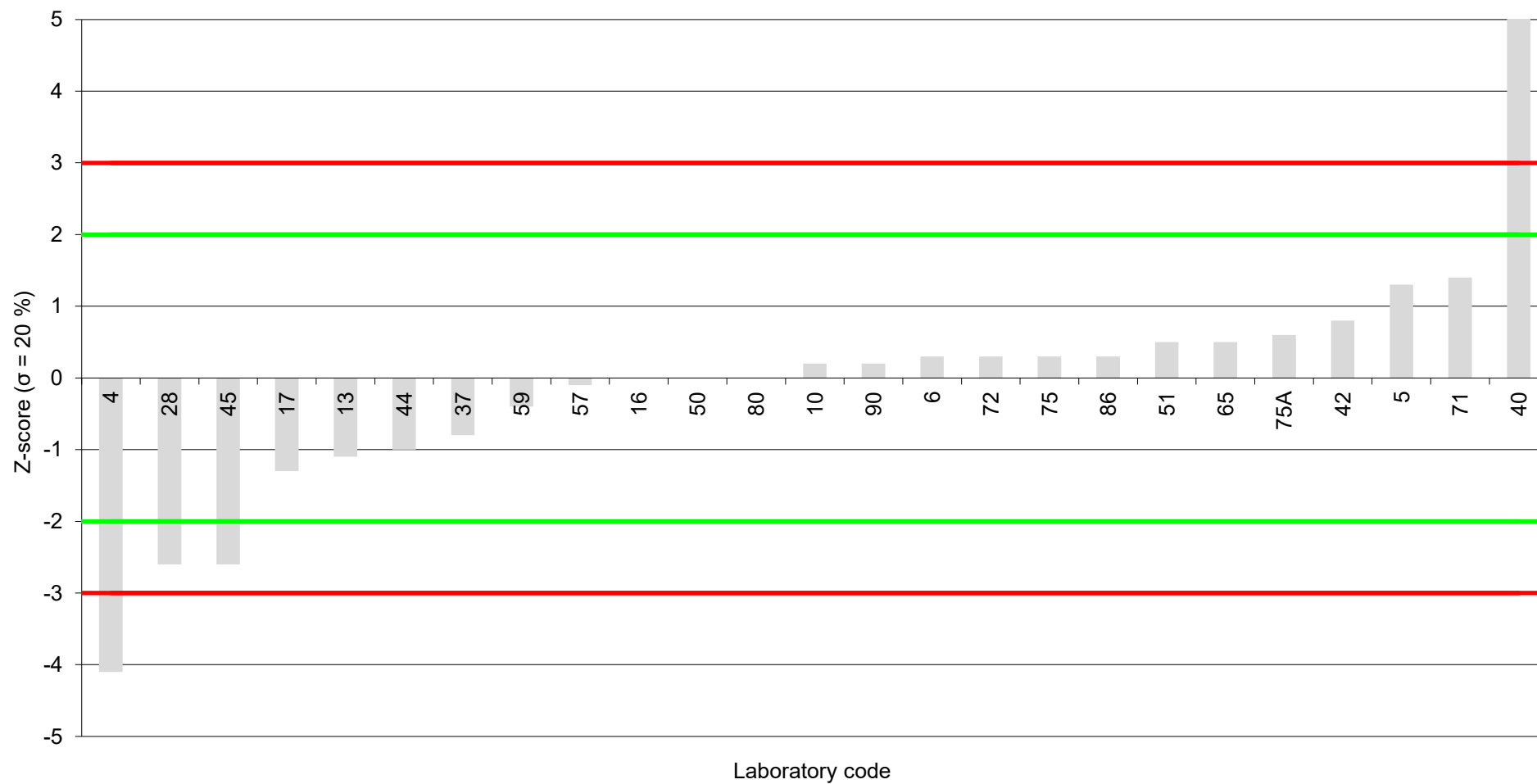
Fish Fillet (2501-FF)
Sum of PBDE without BDE-209 lb
Assigned value: 0.928 µg/kg wet weight



Fish Fillet (2501-FF)
Sum of PBDE including BDE-209 ub
Assigned value: 0.959 µg/kg wet weight



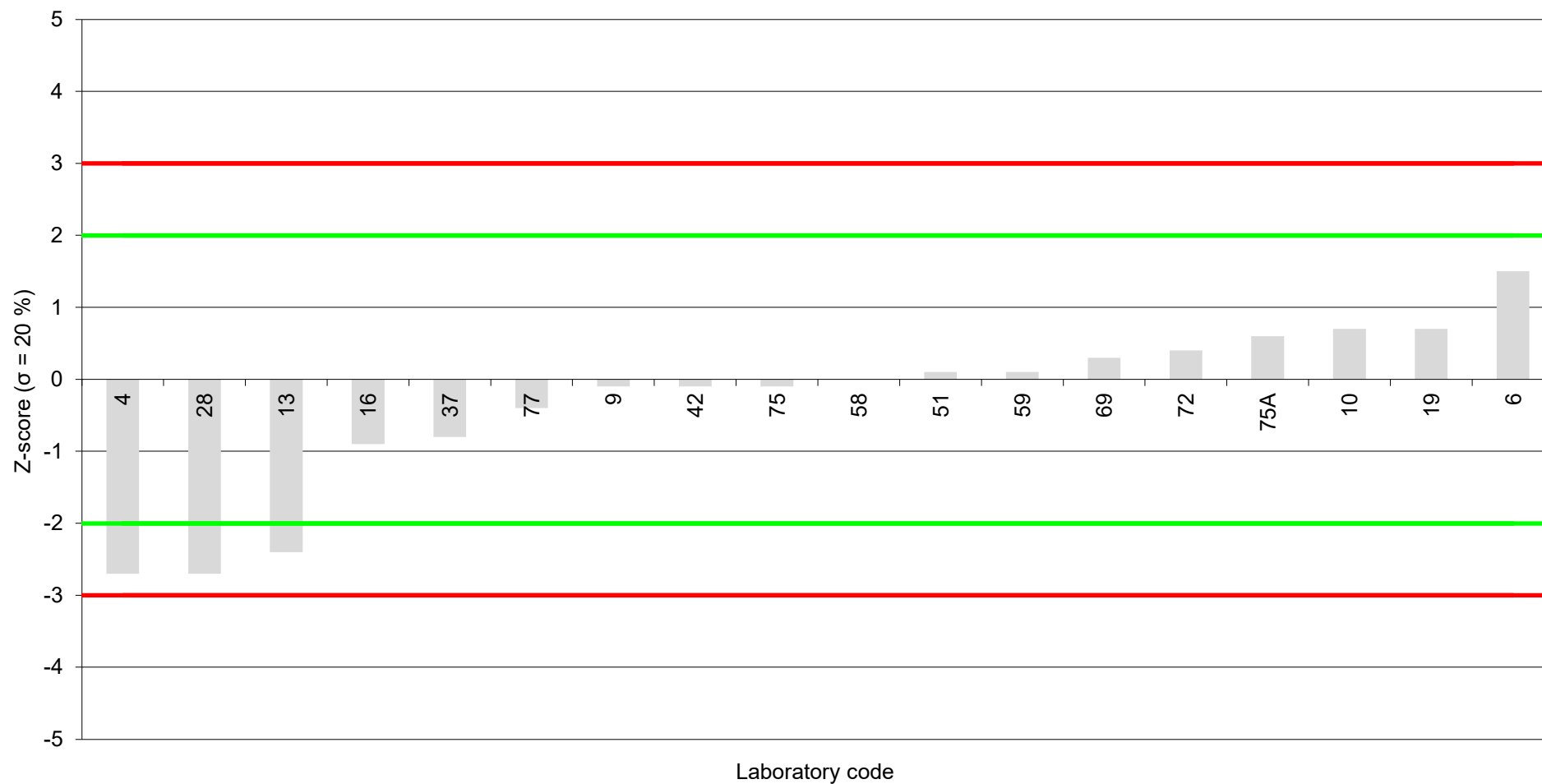
Fish Fillet (2501-FF)
Sum of PBDE including BDE-209 lb
Assigned value: 0.95 µg/kg wet weight



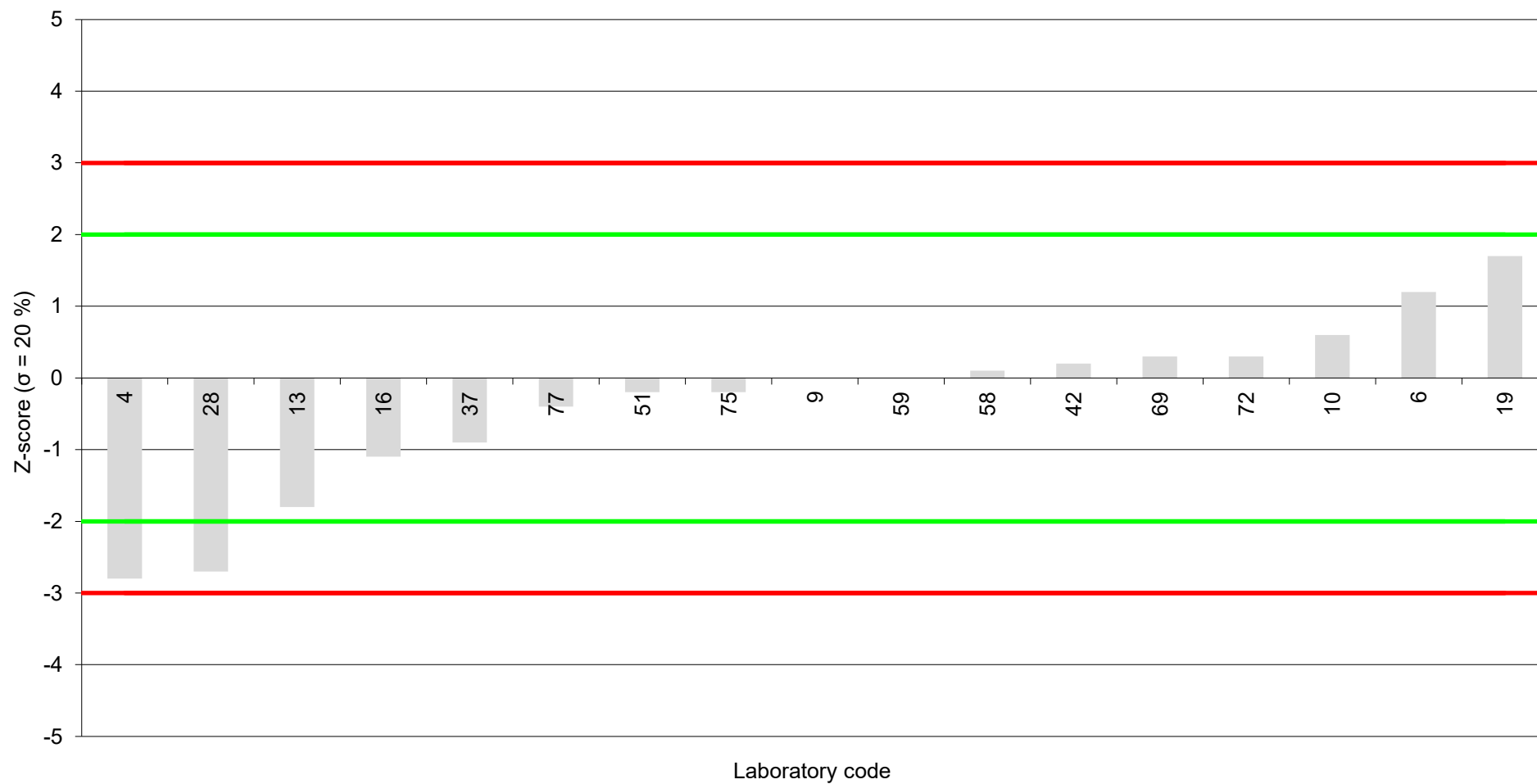
Fish Fillet (2501-FF)

(+/-)- α -HBCDD

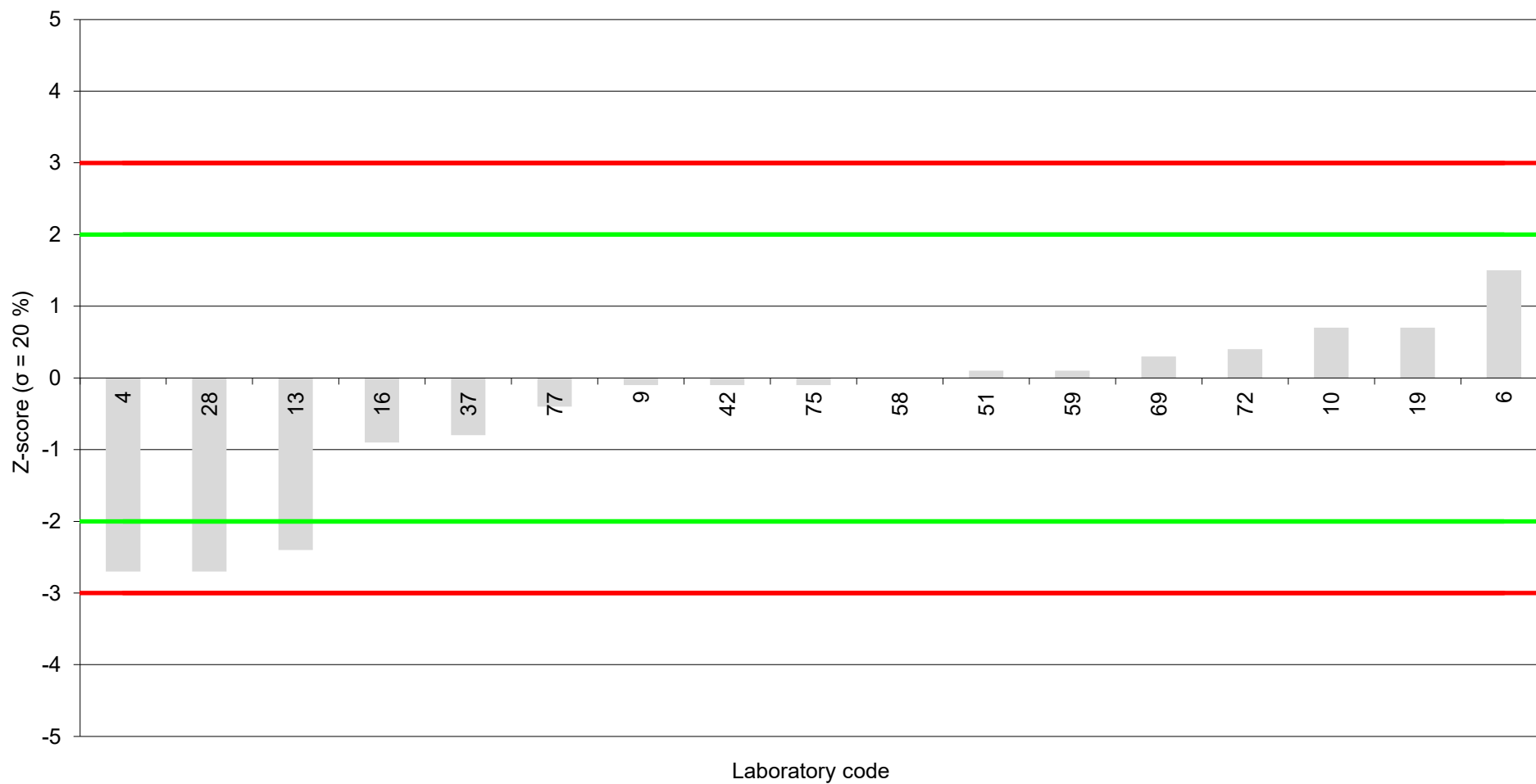
Assigned value: 0.702 $\mu\text{g/kg}$ wet weight



Fish Fillet (2501-FF)
Sum of α -, β -, γ -HBCDD ub
Assigned value: 0.74 $\mu\text{g/kg}$ wet weight



Fish Fillet (2501-FF)
Sum of α -, β -, γ -HBCDD lb
Assigned value: 0.702 $\mu\text{g/kg}$ wet weight





EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

13 February 2026

Annex 5: Test for sufficient homogeneity for PBDEs

Test sample - Fish Fillet (2501-FF)



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for Halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

PBDE - Homogeneity test - Data

Analyte	Result µg/kg wet weight	Mean (n = 10, duplicate analysis)	Median (n = 10, duplicate analysis)	Relative standard deviation [%]
Sum of PBDE without BDE-209 ub		0.769	0.757	10%
Sum of PBDE including BDE-209 ub		0.772	0.763	10%
BDE-28		0.0127	0.0131	10%
BDE-47		0.450	0.443	10%
BDE-49		0.0462	0.0443	11%
BDE-99		0.0507	0.0503	10%
BDE-100		0.133	0.129	10%
BDE-153		0.0237	0.0235	10%
BDE-154		0.0514	0.0506	10%
BDE-183		0.000649	0.000640	12%
BDE-209		0.00680	0.00607	28%



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for Halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

Selected PBDE congeners - Homogeneity test - Data

Sample	Replicate	Result µg/kg wet weight	BDE-153
34	1		0.0117
	2		0.0130
74	1		0.0125
	2		0.0141
100	1		0.0133
	2		0.0116
111	1		0.0124
	2		0.0136
114	1		0.0145
	2		0.0133
120	1		0.0111
	2		0.0131
139	1		0.0114
	2		0.0136
167	1		0.0137
	2		0.0120
192	1		0.0140
	2		0.0094
200	1		0.0120
	2		0.0139
Cochran's C-test			
C			0.451
C _{critical} (α = 0.05, m = 2, n = 10)			0.602
C _{critical} (α = 0.01, m = 2, n = 10)			0.718
C < C _{critical}			yes
Outliers			no evidence for analytical outliers
Homogeneity test			
General average $\bar{x}$			0.013
Standard deviation of sample averages s_x			0.0006
Within-sample standard deviation s_w			0.0015
Between-sample standard deviation s_s			0.0000
Standard deviation for proficiency assessment σ_{PT}			0.0025
s_s / σ_{PT}			0.000
Test for homogeneity ($s_s \leq 0.3 \sigma_{PT}$)			passed



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

13 February 2026

Annex 6: Overview participants' methods – Weighed sample, internal and recovery standards and comments

Test sample - Fish Fillet (2501-FF)



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

Physico-chemical Methods PBDEs - Internal standards

LC	Sample		Weighed sample [g]		Use of isotope-labelled internal standards for ...
					PBDE congeners (yes/no)
4	2501-FF		5.51		yes
5	2501-FF		1.0 - 5.0		yes
6	2501-FF		40.7		yes
9	2501-FF				
10	2501-FF		10		yes
13	2501-FF		30.0		yes
15	2501-FF		6.0		no
16	2501-FF		25.0		yes, exlcuding BDE-49
17	2501-FF		15.5		YES
19	2501-FF				
28	2501-FF		18.0		yes
37	2501-FF		5.2		yes
40	2501-FF		10		yes
41	2501-FF		6		Yes
42	2501-FF		25.0		yes
44	2501-FF		23.1		yes
45	2501-FF		1 and 10 grams		yes
48	2501-FF				yes
50	2501-FF		10.0		yes
51	2501-FF		9.0		YES
57	2501-FF		1		yes
58	2501-FF				
59	2501-FF		10.0		yes
63	2501-FF		62.4		yes (except for BDE-49)
65	2501-FF		20		yes
69	2501-FF		20		yes
70	2501-FF		20.0		yes
71	2501-FF		20.0		yes
72	2501-FF		30		yes
74	2501-FF		16		yes
75	2501-FF		10.0		yes
77	2501-FF				
80	2501-FF		20		yes
86	2501-FF		6		yes
90	2501-FF		120		yes
75A	2501-FF		10		yes



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]
EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)
Methods PBDEs - Internal Standards

LC	Sample	BDE 28	BDE 47	BDE 49	BDE 99	BDE 100	BDE 153	BDE 154	BDE 183	BDE 209
4	2501-FF	13C12-TriBDE (BDE-'28)	13C12-TetraBDE (BDE',47)	13C12-TetraBDE (BDE',47)	13C12-PentaBDE (BDE-'99)	13C12-PentaBDE (BDE-'99)	13C12-HexaBDE (BDE-'153)	13C12-HexaBDE (BDE-'153)	13C12-HeptaBDE (BDE-'183)	13C12-DecaBDE (BDE-'209)
5	2501-FF	13C12-2,4,4'-TriBDE	13C12-2,2',4,4'-TetraBDE	13C12-2,2',4,4'-TetraBDE	13C12-2,2',4,4',5-PentaBDE	13C12-2,2',4,4',6-PentaBDE	13C12-2,2',4,4',5,5'-HexaBDE	13C12-2,2',4,4',5,6'-HexaBDE	13C12-2,2',3,4,4',5',6'-HeptaBDE	13C12-DecaBDE
6	2501-FF	13C-BDE-28	13C-BDE-47	13C-BDE-47	13C-BDE-99	13C-BDE-100	13C-BDE-153	13C-BDE-154	13C-BDE-183	13C-BDE-209
9	2501-FF									
10	2501-FF									
13	2501-FF	13C-BDE-28	13C-BDE-47	13C-BDE-47	13C-BDE-99	13C-BDE-100	13C-BDE-153	13C-BDE-154	13C-BDE-183	13C-BDE-209
15	2501-FF	13C-BDE-155	13C-BDE-155		13C-BDE-155	13C-BDE-155	13C-BDE-155	13C-BDE-155	13C-BDE-155	13C-BDE-209
16	2501-FF	13C12-BDE-28	13C12-BDE-47	13C12-BDE-47	13C12-BDE-99	13C12-BDE-100	13C12-BDE-153	13C12-BDE-154	13C12-BDE-183	13C12-BDE-209
17	2501-FF	13C-BDE-28	13C-BDE-47	13C-BDE-47	13C-BDE-99	13C-BDE-100	13C-BDE-153	13C-BDE-154	13C-BDE-183	13C-BDE-209
19	2501-FF									
28	2501-FF	BDE-28-13C12	BDE-47-13C12	BDE-47-13C12	BDE-99-13C12	BDE-100-13C12	BDE-153-13C12	BDE-154-13C12	BDE-183-13C12	BDE-209-13C12
37	2501-FF	13C-BDE28	13C-BDE47	13C-BDE47	13C-BDE99	13C-BDE100	13C-BDE153	13C-BDE154	13C-BDE183	13C-BDE209
40	2501-FF	C13-BDE-28	C13-BDE-47		C13-BDE-99	C13-BDE-100	C13-BDE-153	C13-BDE-154	C13-BDE-183	C13-BDE-209
41	2501-FF	13C-BDE-28	13C-BDE-47	13C-BDE-47	13C-BDE-99	13C-BDE-99	13C-BDE-153	13C-BDE-154	13C-BDE-183	
42	2501-FF	13C-BDE-28	13C-BDE-47	13C-BDE-47	13C-BDE-99	13C-BDE-100	13C-BDE-153	13C-BDE-154	13C-BDE-183	13C-BDE-209
44	2501-FF	13C BDE-28	13C BDE-47	13C BDE-47	13C BDE-99	13C BDE-100	13C BDE-153	13C BDE-154	13C BDE-183	13C BDE-209
45	2501-FF	13C-BDE-28	13C-BDE-47	13C-BDE-47	13C-BDE-99	13C-BDE-100	13C-BDE-153	13C-BDE-154	13C-BDE-183	13C-BDE-209
48	2501-FF	BDE 28 (13C12)	BDE 47 (13C12)		BDE 99 (13C12)	BDE 100 (13C12)	BDE 153 (13C12)	BDE 154 (13C12)	BDE 183 (13C12)	
50	2501-FF	13C12 BDE-28	13C12 BDE-47	13C12 BDE-47	13C12 BDE-99	13C12 BDE-100	13C12 BDE-153	13C12 BDE-154	13C12 BDE-183	13C12 BDE-209
51	2501-FF	13C BDE-28	13C BDE-47	13C BDE-47	13C BDE-99	13C BDE-100	13C BDE-153	13C BDE-154	13C BDE-183	13C BDE-209
57	2501-FF	BDE-28L	BDE-47L		BDE-99L	BDE-100L	BDE-153L	BDE-154L	BDE-183L	BDE-209L
58	2501-FF									
59	2501-FF	13C12 BDE 28	13C12 BDE 47	13C12 BDE 47	13C12 BDE 99	13C12 BDE 100	13C12 BDE 153	13C12 BDE 154	13C12 BDE 183	13C12 BDE 209
63	2501-FF	BDE-28	BDE-47	BDE-47	BDE-99	BDE-100	BDE-153	BDE-154	BDE-183	
65	2501-FF	13C12-MBDE 28	13C12-MBDE 47	13C12-MBDE 47	13C12-MBDE 99	13C12-MBDE 100	13C12-MBDE 153	13C12-MBDE 154	13C12-MBDE 183	13C12-MBDE 209
69	2501-FF	13C12-PBDE 28	13C12-PBDE 47	13C12-PBDE 47	13C12-PBDE 99	13C12-PBDE 100	13C12-PBDE 153	13C12-PBDE 154	13C12-PBDE 183	-
70	2501-FF	(BDE-28) L	(BDE-47) L		(BDE-99) L	(BDE-100)L	(BDE-153)L	(BDE-154)L	(BDE-183)L	
71	2501-FF	BDE-28	BDE-47	BDE47	BDE-99	BDE-100	BDE-153	BDE-154	BDE-183	BDE-209
72	2501-FF	MBDE-28	MBDE-47	MBDE-47	MBDE-99	MBDE-100	MBDE-153	MBDE-154	MBDE-183	MBDE-209
74	2501-FF	MBDE-28	MBDE-47	MBDE-47	MBDE-99	MBDE-99	MBDE-153	MBDE-153	MBDE138	
75	2501-FF	BDE-28	BDE-47	BDE-47	BDE-99	BDE-100	BDE-153	BDE-154	BDE-183	BDE-209
77	2501-FF									
80	2501-FF	13C12-MBDE 28	13C12-MBDE 47	13C12-MBDE 47	13C12-MBDE 99	13C12-MBDE 100	13C12-MBDE 153	13C12-MBDE 154	13C12-MBDE 183	13C12-MBDE 209
86	2501-FF	13C12-BDE-28	13C12-BDE-47	13C12-BDE-47	13C12-BDE-99	13C12-BDE-100	13C12-BDE-153	13C12-BDE-154	13C12-BDE-183	13C12-BDE-209
90	2501-FF	13C-BDE-28	13C-BDE-47	13C-BDE-47	13C-BDE-99	13C-BDE-100	13C-BDE-153	13C-BDE-154	13C-BDE-183	13C-BDE-209
75A	2501-FF	BDE-28	BDE-47	BDE-47	BDE-99	BDE-100	BDE-153	BDE-154	BDE-183	BDE-209



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]
EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)
Methods PBDEs - Comments

LC	Sample		BDE 28	BDE 47	BDE 49	BDE 99	BDE 100	BDE 153	BDE 154	BDE 183	BDE 209
4	2501-FF										
5	2501-FF										
6	2501-FF										
9	2501-FF										
10	2501-FF										
13	2501-FF										
15	2501-FF			n.a							
16	2501-FF										
17	2501-FF										
19	2501-FF										
28	2501-FF										
37	2501-FF										
40	2501-FF			not measured							
41	2501-FF										
42	2501-FF										
44	2501-FF										
45	2501-FF		Procedural extraction was carried out without RS	Procedural extraction was carried out without RS	Procedural extraction was carried out without RS	Procedural extraction was carried out without RS	Procedural extraction was carried out without RS	Procedural extraction was carried out without RS	Procedural extraction was carried out without RS	Procedural extraction was carried out without RS	Procedural extraction was carried out without RS
48	2501-FF		< LOQ		not analyzed			< LOQ		< LOQ	not analyzed
50	2501-FF										
51	2501-FF										
57	2501-FF				not determined						
58	2501-FF										
59	2501-FF										
63	2501-FF										
65	2501-FF										
69	2501-FF										not analysed
70	2501-FF				Undetermined						Undetermined
71	2501-FF										
72	2501-FF										
74	2501-FF										
75	2501-FF										
77	2501-FF										
80	2501-FF										
86	2501-FF										
90	2501-FF										
75A	2501-FF										



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]
EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)
Physico-chemical Methods HBCDDs - Internal standards

LC	Sample	Weighed sample [g]	Use of isotope-labelled internal standards for ... HBCDD diastereomers (yes/no)
4	2501-FF	5.09	yes
5	2501-FF		
6	2501-FF	40.7	yes
9	2501-FF	10	yes
10	2501-FF	10	yes
13	2501-FF	30	yes
15	2501-FF	6	no
16	2501-FF	18	yes
17	2501-FF		
19	2501-FF	4	yes
28	2501-FF	18	yes
37	2501-FF	9.5	yes
40	2501-FF		
41	2501-FF		
42	2501-FF	25	yes
44	2501-FF		
45	2501-FF		
48	2501-FF		
50	2501-FF		
51	2501-FF	9.4	YES
57	2501-FF		
58	2501-FF	10	Yes
59	2501-FF	10	yes
63	2501-FF		
65	2501-FF		
69	2501-FF	5	yes
70	2501-FF	20	no
71	2501-FF	20	yes
72	2501-FF	10	yes
74	2501-FF		
75	2501-FF	10	yes
77	2501-FF	2.5	yes
80	2501-FF		
86	2501-FF		
90	2501-FF		



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]
EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)
Methods HBCDDs - Internal Standards

LC	Sample	(+/-)-α-HBCDD	(+/-)-β- HBCDD	(+/-)-γ- HBCDD
4	2501-FF	13C12-alpha-HBCD	13C12-beta-HBCD	13C12-gamma-HBCD
5	2501-FF			
6	2501-FF	13C-α-HBCD	13C-β-HBCD	13C-γ-HBCD
9	2501-FF			
10	2501-FF	13C-(+/-)-α-HBCDD	13C-(+/-)-β-HBCDD	13C-(+/-)-γ- HBCDD
13	2501-FF	13C-alpha-HBCDD	13C-beta-HBCDD	13C-gamma-HBCDD
15	2501-FF			
16	2501-FF	13C alphaHBCDD	13C betaHBCDD	13C gammaHBCDD
17	2501-FF			
19	2501-FF	C13 alfa-HBCD	C13 alfa-HBCD	C13 alfa-HBCD
28	2501-FF	alfa-HBCD-13C12	gamma-HBCD-13C12	gamma-HBCD-13C12
37	2501-FF	13C-a-HBCD	13C-B-HBCD	13C-j-HBCD
40	2501-FF			
41	2501-FF			
42	2501-FF	13C-α-HBCDD	13C-β-HBCDD	13C-γ-HBCDD
44	2501-FF			
45	2501-FF			
48	2501-FF			
50	2501-FF			
51	2501-FF	13C-α-HBCDD	13C-β-HBCDD	13C-γ-HBCDD
57	2501-FF			
58	2501-FF	13C-A-HBCD	13C-B-HBCD	13C-Y-HBCD
59	2501-FF	13C12 alfa-HBCDD	13C12 beta-HBCDD	13C12 gamma-HBCDD
63	2501-FF			
65	2501-FF			
69	2501-FF	alfa-HBCDD (13C12)	beta-HBCDD (13C12)	gamma-HBCDD (13C12)
70	2501-FF			
71	2501-FF			
72	2501-FF	13C12-alpha-HBCDD	13C12-beta-HBCDD	13C12-gamma-HBCDD
74	2501-FF			
75	2501-FF	alpha-HBCDD	beta-HBCDD	gamma-HBCDD
77	2501-FF	13C12-α-HBCDD	13C12-β-HBCDD	13C12-γ-HBCDD
80	2501-FF			
86	2501-FF			
90	2501-FF			
75A	2501-FF	alpha-HBCDD	beta-HBCDD	gamma-HBCDD



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]
EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

Methods HBCDDs - Recovery Standards

LC	Sample	(+/-)-α-HBCDD	(+/-)-β- HBCDD	(+/-)-γ- HBCDD
4	2501-FF	d18-beta-HBCD	d18-beta-HBCD	d18-beta-HBCD
5	2501-FF			
6	2501-FF	13C-δ-HBCD	13C-δ-HBCD	13C-δ-HBCD
9	2501-FF			
10	2501-FF			
13	2501-FF	-	-	-
15	2501-FF			
16	2501-FF	d18-racbeta-1,2,5,6,9,10 - Hexabromocyklododecane	d18-racbeta-1,2,5,6,9,10 - Hexabromocyklododecane	d18-racbeta-1,2,5,6,9,10 - Hexabromocyklododecane
17	2501-FF			
19	2501-FF			
28	2501-FF	beta-HBCD-13C12	beta-HBCD-13C12	beta-HBCD-13C12
37	2501-FF	none	none	none
40	2501-FF			
41	2501-FF			
42	2501-FF	2H-α-HBCDD	2H-β-HBCDD	2H-γ-HBCDD
44	2501-FF			
45	2501-FF			
48	2501-FF			
50	2501-FF			
51	2501-FF	d18-β-HBCDD	d18-β-HBCDD	d18-β-HBCDD
57	2501-FF			
58	2501-FF	D18-B-HBCD	D18-B-HBCD	D18-B-HBCD
59	2501-FF			
63	2501-FF			
65	2501-FF			
69	2501-FF			
70	2501-FF			
71	2501-FF			
72	2501-FF	alpha-HBCDD-d18	beta-HBCDD-d18	gamma-HBCDD-d18
74	2501-FF			
75	2501-FF	D18-beta-HBCDD	D18-beta-HBCDD	D18-beta-HBCDD
77	2501-FF	N/A	N/A	N/A
80	2501-FF			
86	2501-FF			
90	2501-FF			
75A	2501-FF	D18-beta-HBCDD	D18-beta-HBCDD	D18-beta-HBCDD



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

13 February 2026

Annex 7: Overview participants' methods – Extractions, clean-up and detection

Test sample - Fish Fillet (2501-FF)

EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]
EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)
Physico-chemical Methods PBDEs - Pre-treatment and extraction

LC		Pre-treatment and extraction					
Sample		Sample preparation/pre-treatment	Extraction technique	Extraction solvent	Extraction time [h]	Extraction temperature [°C]	Extraction pressure [MPa]
4	2501-FF	homogenization, drying with polyacrylamide	cold extraction	hexane		room temperature	
5	2501-FF	lyophilization	ASE	Hexane/Cyclohexan (50/50)	0.3	120	10
6	2501-FF	homogenize	shaking with solvent	hexane/acetone 50/50	0.1 for each step (4 consecutive extractions)	20	
9	2501-FF						
10	2501-FF		cold extraction				
13	2501-FF	drying with PAA	Twisselmann	Cyclohexan / Toluol (1:1, v/v)	6	boiling point	
15	2501-FF	none	Liquid-liquid extraction	Hexane, acetone, hexane/diethylether 9/1			
16	2501-FF	freeze-dried	Accelerated Solvent Extraction (ASE) - ASE 250	dichloromethane/ n-hexane (50/50)	0.35	100	10
17	2501-FF	Freeze Drying	SOXHLET	HEXANE/DCM (1/1)	24H		
19	2501-FF						
28	2501-FF	no	QuEChERS like-extraction	Ethyl acetate	no	no	no
37	2501-FF		LL Extraction/Adding silica/H2SO4 40% and then extraction with 10 ml hexane (2x). Evaporated to dryness.	Ethylacetate/Hexane	over night	Roomtemp	
40	2501-FF		ASE	pentane/acetone 88/12	0,5	80	1500
41	2501-FF	No	Soxhlet	Dichloromethane	18	Boiling point	
42	2501-FF	drying	ASE	toluene (85%) / ethanol (15%)	20 min	120	10
44	2501-FF	Freeze-drying	ASE	Hexane	2 cycles a 5 min	100	10
45	2501-FF	none	Modified quechers (NaCl salts partitioning)	Ethyl acetate	10min	room temperature	none
48	2501-FF	drying	ASE	cyclohexane / ethylacetate 1 / 1	0,75	120	120
50	2501-FF	Drying with sodium polyacrylate	ASE	(1) Toluene - (2) Toluene:Ethanol 90:10	0.25	100°C	10.3
51	2501-FF	drying	PLE	Toluene/Acetone			
57	2501-FF	freeze drying	cold solvent extraction	hexane/acetone 2/1	2	room temperature	atmospheric pressure
58	2501-FF						
59	2501-FF	drying	UAE	DCM:hexane (1:1)	1	40	room
63	2501-FF	sample mixed with sodium sulphate before extraction	Soxhlet	DCM:Hexane (50:50)	24 h		
65	2501-FF	PAA	twisselman	Cyclohexan/Toluol (50/50)	8	boiling point	
69	2501-FF	thorough homogenization, drying with anhydrous Sodium Sulfate	Soxhlet (ultrasonic bath, agitate)	cyclohexane:2-propanol 2:1	21	109	0.1
70	2501-FF	drying	Soxhlet (hot extraction)	Hexane/acetone 80/20	1	50	Atmospheric
71	2501-FF	Homogenisation	LLE (Jensen method)	iso-propanol, diethylether, n-hexane	1h	ambient T	ambient P
72	2501-FF	mixing with sodiumsulfate	cold extraction	DCM/Cyclohexane 1/1	roughly 2-3 hours	ambient	ambient
74	2501-FF		Solid-liquid extraction	n-hexane:dichloromethane (9:1)	2	room temperature	
75	2501-FF	drying	ASE	Hexane/Acetone (70:30)	1	125	10.3
77	2501-FF						
80	2501-FF	freeze drying	twisselman	Cyclohexan/Toluol (50/50)	8	boiling point	
86	2501-FF	no	Soxhlet	Toluene			
90	2501-FF	Freeze-drying	Twisselman	Toluene / Cyclohexan (50/50)	6		
75A	2501-FF		QuEChERS	Acetonitrile/Toluene (3:1 v/v)	overnight	room temperature	



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

Physico-chemical Methods PBDEs - Clean-up

LC	Sample	Clean-up						Final volume [µl]: PBDE
		Gelchromatography	Silica/sulfuric acid column	Florisil column	Alumina column	Carbon column	Others	
4	2501-FF	no	yes	no	yes	no		100
5	2501-FF	yes	yes	no	yes	yes		50
6	2501-FF	no	yes	no	yes	no		25
9	2501-FF							
10	2501-FF	no	yes	no	yes	yes		100
13	2501-FF	no	yes	no	yes	yes	no	100
15	2501-FF	no	no	no	no	no	sulfuric acid treatment and silica column	200
16	2501-FF	no	yes	yes	yes	no	no	80
17	2501-FF	NO	YES	NO	YES	NO	NO	20
19	2501-FF							
28	2501-FF	yes	yes	no	no	no	no	250
37	2501-FF	no	yes	no	no	no	no	250 µl
40	2501-FF	no	yes	no	yes	yes	Silver nitrate column	1000
41	2501-FF	No	Yes	No	Yes	No		50
42	2501-FF	no	yes	no	yes	yes	no	500
44	2501-FF	no	yes	no	yes	yes	silver nitrate column	60
45	2501-FF	no	no	no	no	no	sulfuric acid attack + freezing -80°C for 1hour	300
48	2501-FF	no					HPLC Nucleosil 100-7	1000
50	2501-FF	no	yes	no	yes	yes	-	100
51	2501-FF	YES	YES	YES	NO	YES		50
57	2501-FF	no	yes	no	yes	yes		30
58	2501-FF							
59	2501-FF	yes	yes	no	no	yes		20
63	2501-FF	no	yes	no			basic set of "power-prep system" columns	40
65	2501-FF	no	yes	no	yes	yes	no	400
69	2501-FF	no	yes	no	yes	yes	basic silica, silver nitrate silica	50
70	2501-FF	no	yes	no	yes	yes	no	60
71	2501-FF	no	yes	no	yes	yes	Power-Prep FMS (silica/alumina/carbon columns)	20
72	2501-FF	no	yes	no	yes	yes	AgNO3 (MIURA)	50
74	2501-FF	no					acid treatment + SPE silica	300
75	2501-FF	no	yes	no	yes	no	acid hydrolysis with sulphuric acid	80
77	2501-FF							
80	2501-FF	no	yes	no	yes	yes	no	400
86	2501-FF	no	yes	no	yes	yes	Silica/AgNO3	100
90	2501-FF	no	yes	no	yes	no	acidic treatment	50
75A	2501-FF	no	no	no	no	no	acid hydrolysis with sulphuric acid followed by dispersive SPE (Z-S)	25



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

Physico-chemical Methods PBDEs - Chromatographic separation and detection method

LC	Sample	Chromatographic separation and detection method			
		GC injection	Injected volume [µl]	Chromatographic separation: Stationary phase	Detector
4	2501-FF	pulsed splitless	2	Diphenyl-/dimethylpolysiloxan (5%/95%)	MS/MS
5	2501-FF	PTV	5	5% diphenyl, 95% dimethyl polysiloxane (RTX-1614)	MS/MS
6	2501-FF	splitless	1	Rtx-1614	HRMS
9	2501-FF				
10	2501-FF	splitless	2	DB 5	HRMS
13	2501-FF	splitless	1	Rtx 1614, 15 m x 0.25 mm, 0.1 µm	APGC-MS/MS
15	2501-FF	PTV, Pulsed splitless	6	DB-5MS (5 % phenyl-95 % dimethylarylsiloxane)	LRMS
16	2501-FF	PTV Splitless	1.5	RTX 1614 15 m x 0.25 mm (BDE-209), 0.1µm;DB-5ms 60m x 0.25 mm, 0.1µm	HRMS
17	2501-FF	SPLITLESS	1	DB-5ms 40m x 0,18 mm x 0,18 um	HRMS
19	2501-FF				
28	2501-FF	PTV	10	DB5HT 15 m x 0.25 mm; 0.1 um	MS/MS
37	2501-FF	PTV	100	Rtx-CIPesticides	GC-HRMS
40	2501-FF	PTV	1	DB-5MS	HRMS
41	2501-FF	Splitless	1.5	DB-5MS	HRMS, DFS
42	2501-FF	splitless	5	(5%-phenyl)-methylpolysiloxane	MSMS
44	2501-FF	Splitless	2	TRACE-GOLD TG-PBDE	MS/MS
45	2501-FF	PTV	6	HT-5MS 5% fenil - 95 % 15m, 0.18um and 0.1um	HRMS
48	2501-FF	PTV	10	ZB-5HT Inferno	MS/MS
50	2501-FF	PTV	5	RTX-1614 (15x0.25x0.10)	HRMS
51	2501-FF	Splitless	2	HT8PCB	GC-HRMS
57	2501-FF	PTV	1	5 m precolumn and 30 m Rtx-1614 0.25 mm x 0.1 µm	HRMS
58	2501-FF				
59	2501-FF	PTV	5	Phenomenex Zebron ZB-Semivolatiles	
63	2501-FF	Splitless	1	DB-5MS (30 m, 0.25 mm id, 0,25 mm film)	HRMS (Mat-95 XP)
65	2501-FF	splitless	2	Rtx-1614, 30m	HRMS (DFS)
69	2501-FF	pulsed splitless	1	DB-5MS (60m x 0,25mm x 0,10 µm)	HRMS (R>10000)
70	2501-FF	Split Splitless	1	5% Polysilarylene - 95% Polydimethylsyloxane (Zebron-dioxins)	MS/MS
71	2501-FF	splitless	2	DB-5ht (15m x 0,25mm x 0,10um)	HRMS
72	2501-FF	large volume	4	Rtx-1614 (15m x 0,25 mm x 0,1 µm) + 1,5m retention gap	MS/MS
74	2501-FF	PTV large volume	20	5MS	MS/MS
75	2501-FF	PTV	2	Rtx-1614 30m x 0.25mm x 0.1µm	HRMS
77	2501-FF				
80	2501-FF	splitless	2	Rtx-1614, 30m	HRMS (DFS)
86	2501-FF	PTV	1	ZB-Semivolatile 20m, 0.18mm, 0.18µm	MS/MS
90	2501-FF	splitless	2.0	DB-5HT	HRMS (Autospec Ultima Waters)
75A	2501-FF	LC	5	Luna Omega PS C18 (1,6 um 2,1x 150 mm)	APCI-HRMS

EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

Physico-chemical Methods HBCDDs - Pre-treatment and extraction

LC	Sample	Pre-treatment and extraction				
		Sample preparation/pre-treatment	Extraction technique	Extraction solvent	Extraction time [h]	Extraction temperature [°C]
4	2501-FF	homogenization	Quechers	acetonitrile/water (1/1)	10 min	room temperature
5	2501-FF					
6	2501-FF	homogenize	shaking with solvent	hexane/acetone 50/50	0.1 for each step (4 consecutive extractions)	20
9	2501-FF	Freeze-drying	Mechanical shaking	Hexane/Dichloromethane 50/50	0.33	20
10	2501-FF		cold extraction	DCM/Cyclohexan 1/1		Ambiant
13	2501-FF	freeze drying	Twisselmann	Cyclohexan / Toluol (1:1, v/v)	6	boiling point
15	2501-FF					
16	2501-FF	Freeze drying.	ASE 350	dichloromethane/hexane (50/50)	0.35	100
17	2501-FF					10
19	2501-FF		Soxleth	Acetone/Hexane (1/1)	6	
28	2501-FF	no	QuEChERS like-extraction	Ethyl acetate	no	no
37	2501-FF	Sodium Sulfate	ASE	Hexane/Acetone 1:1	30 minutes	100
40	2501-FF					1500 psi
41	2501-FF					
42	2501-FF	drying	ASE	toluene (85%) / ethanol (15%)	20 min	120
44	2501-FF					10
45	2501-FF					
48	2501-FF					
50	2501-FF					
51	2501-FF	drying	PLE	Toluene/Acetone		
57	2501-FF					
58	2501-FF	Microwave	ASE	50:50 Acetone:Hexane	0.5	100
59	2501-FF	drying	UAE	DCM:hexane	1	40
63	2501-FF					room
65	2501-FF					
69	2501-FF	drying	shaking with dichlormethan : acetone 2:1 for 90 min	100 ml of dichlormethan : acetone 2:1	90 min	ambient
70	2501-FF					0.10
71	2501-FF	Homogenisation	LLE (Jensen method)	iso-propanol, diethylether, n-hexane	1h	ambient T
72	2501-FF	mixing with natriumsulfate	cold extraction	DCM/Hexan 1/1	roughly 2-3 hours	ambient
74	2501-FF					ambient P
75	2501-FF	drying	ASE	Hexane/Acetone (70:30)	1	125
77	2501-FF	Drying using sodium sulfate	Ultrasound assisted extraction	DCM:Hex (1:1, v/v)	30 min	Room temp.
80	2501-FF					10.3
86	2501-FF					N/A
90	2501-FF					
75	2501-FF		QuEChERS	Acetonitrile/Toluene (3:1 v/v)	overnight	room temperature



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

Physico-chemical Methods HBCDDs - Clean-up

LC	Sample	Clean-up						
		Gelchromatography	Silica/sulfuric acid column	Florisil column	Alumina column	Carbon column	Others	Final volume [µl]: HBCDD
4	2501-FF	no	yes	no	no	no		1000
5	2501-FF							
6	2501-FF	no	yes	no	no	no		1000
9	2501-FF	no	yes	no	no	no		200
10	2501-FF	yes	no	yes	no	no		100
13	2501-FF	no	yes	yes	no	no	no	100
15	2501-FF							
16	2501-FF	no	yes	no	no	no		50
17	2501-FF							
19	2501-FF	no	no	no	no	no	Conc. sulphuricacid	200
28	2501-FF	yes	no	no	no	no	Extrelut NT-3 column, acidic for H2SO4 tandem Si 1g/6 mL column	250
37	2501-FF	no	yes	no	no	no		500 µl
40	2501-FF							
41	2501-FF							
42	2501-FF	no	yes	no	no	no	no	500
44	2501-FF							
45	2501-FF							
48	2501-FF							
50	2501-FF							
51	2501-FF	YES	YES	NO	NO	NO	liquid liquid extraction	50
57	2501-FF							
58	2501-FF	No	Yes	Yes	No	No	None	100
59	2501-FF	yes	yes	no	no	yes		200
63	2501-FF							
65	2501-FF							
69	2501-FF	yes	yes	no	no	no		500
70	2501-FF							
71	2501-FF	no	yes	no	no	no	no	20
72	2501-FF	no	yes	no	no	no	no	400
74	2501-FF							
75	2501-FF	no	yes	no	no	no	acid hydrolysis with sulphuric acid	200
77	2501-FF	No	Yes (both)	Yes	No	No	Direct H2SO4 treatment	50
80	2501-FF							
86	2501-FF							
90	2501-FF							
75A	2501-FF	no	no	no	no	no	acid hydrolysis with sulphuric acid followed by dispersive SPE (Z-SEP+)	25



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

Physico-chemical Methods HBCDDs - Chromatographic separation and detection method

LC	Sample	Chromatographic separation and detection method			
		Injection	Injected volume [µl]	Chromatographic separation: Stationary phase	Detector
4	2501-FF	standard	10	C18	MS/MS
5	2501-FF				
6	2501-FF	LC	10	Acquity BEH C18 150 mm	MS/MS
9	2501-FF	UPLC	5	Eclipse Plus C18, 2,1 x 100mm	MS/MS
10	2501-FF		10	RP 18	LC-MS/MS
13	2501-FF	HPLC	2	C18	MS/MS
15	2501-FF				
16	2501-FF		10	Hypersil Gold C18, 100x2,1mm, 1,9µm	MS/MS
17	2501-FF				
19	2501-FF	HPLC injection	5	Acquity BEH C18 (1.7 µm, 2.1*100 mm)	MS/MS
28	2501-FF		20 µL	KINETEX 2.6µm XB-C18 100A (100 x 2.1 mm) (PHENOMENEX)	LC-MS/MS
37	2501-FF		10	C18 (Waters symmetry), 150 mm x 2.1 mm x 3.5 µm	LCMSMS
40	2501-FF				
41	2501-FF				
42	2501-FF	ESI negative	7 µl	C18 columnn	MS/MS
44	2501-FF				
45	2501-FF				
48	2501-FF				
50	2501-FF				
51	2501-FF		3	Hypersil Gold	MS/MS
57	2501-FF				
58	2501-FF		10	C18	HRMS (Hybrid Quadrupole/Orbitrap)
59	2501-FF		70	Luna PHP	MS/MS
63	2501-FF				
65	2501-FF				
69	2501-FF	normal	10	C18	MS/MS
70	2501-FF				
71	2501-FF	splitless	2	DB-5ht (15m x 0,25mm x 0,10µm)	HRMS
72	2501-FF		15	C18	MS/MS
74	2501-FF				
75	2501-FF		5	BEH C18 (50 mm x 2.1 mm; 1.7 µm)	HRMS
77	2501-FF	-	5	C18-RP-HPLC	HRMS
80	2501-FF				
86	2501-FF				
90	2501-FF				
75A	2501-FF	LC	5	Luna Omega PS C18 (1,6 um 2,1x 150 mm)	APCI-HRMS



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs, HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

13 February 2026

Annex 8: Overview participants' methods – Measurement uncertainty and Limit of Quantification

Test sample - Fish Fillet (2501-FF)



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

Determination of Limit of Detection and Measurement Uncertainty (MU) - PBDEs

Methods applied to determine		Additional Information	
LC	Sample	Limit of Quantification (LOQ)	Measurement Uncertainty (MU)
4	2501-FF		
5	2501-FF	Estimation by sample	by methode validation
6	2501-FF		
9	2501-FF		
10	2501-FF	S/N 3:1	
13	2501-FF		
15	2501-FF	for analytes not found in solventblanks LOQ= lowest validated level, analytes found in blanks LOQ= m+3SD of blank levels	
16	2501-FF	LOQ was obtained from blank samples made in the same batch as PT samples.	Obtained during method validation additional, MUs were compared with a standard deviation of PT sample, higher value was taken to report.
17	2501-FF		
19	2501-FF		
28	2501-FF	Samples spiked at LOQ level (5 pg/g; 100ppg for BDE 209); for BDE 47 LOQ (15 pg/g) was estimated from procedural blanks run within the sample batch	Nordtest
37	2501-FF	according to NEN 7777 And determined by software with taking the blank vaqlues into account And determined by software with taking the blank vaqlues into account	according to NEN 7777 expanded measurement uncertainty
40	2501-FF	Automatical calculated by TargetQuan	
41	2501-FF		
42	2501-FF		
44	2501-FF	Based on determination of blanks during validation. Set numbers divided by sample weight.	RSD (%) was based on multiple analysis on known material during validation, then 2 x RSD(%) + 5.
45	2501-FF	0,010 ng/g by injection of an spiked sample	study of recovery for different samples and days at 3 different levels of concentration + Horwitz equation
48	2501-FF		
50	2501-FF	Signal to noise in the validation & derived from blanks	From old PT material using the EURL excel sheet for dioxins
51	2501-FF	S/N > 3	Co-extraction with the dioxins and pcbs
57	2501-FF	LOQ of each individual congener is determined by TargetQuan and has the factors 3 for noise and 2 for sigma.	MU is calculated from the standard deviation of the repetition in the laboratory and that of the interlaboratory comparison and is valid for relevant contents
58	2501-FF		
59	2501-FF	lowest spiked level meeting criteria fro inter-day precision (RSD 20%) and trueness (70-130%)	MU was calculated on the basis of fortification experiments, by summing contributions of errors from reproducibility and deviation from theoretical (spiked) value
63	2501-FF		
65	2501-FF		
69	2501-FF		
70	2501-FF		
71	2501-FF	LOQ = 3 x LOD; LOD evaluated as 3 times of noise	Expanded U: Ue = k x Uc (k = 2). MU of type A is evaluated using internal RM. U of type B (includes i.a. uncertainty of weighing, volume measurements, etc.) Uc = combined uncertainty is summed uncertainty of type A and B according the law of propagation of measurement uncertainty
72	2501-FF	according to the lowest validated level LOD evaluated as 3 times of noise	top-down approach as discribed in the "Guidance document on measurment uncertainty for laboratories performing PCDD/F and PCB analysis"
74	2501-FF		
75	2501-FF	The LOQs were estimated using the approach "Congener-based LOQs from S/N Calculations". This methodology is reported in the Guidance Document on the Estimation of LOD and LOQ for Measurements in the Field of Contaminants in Feed and Food.	The MU was estimated using the "semi-empirical approach" based on the ISO Guide to the expression of Uncertainty in Measurement applied to analytical chemistry by EURACHEM/CITAC. This approach is reported in the Guidance Document on Measurement Uncertainty for Laboratories performing PCDD/F and PCB Analysis using Isotope Dilution Mass Spectrometry
77	2501-FF		
80	2501-FF		
86	2501-FF	Mean of Blank + 3s	multiple analysis of reference material
90	2501-FF		



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]
EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)
Methods PBDEs - Limit of detection (LOQ) in µg/kg wet weight

LC	Sample									
		BDE 28	BDE 47	BDE 49	BDE 99	BDE 100	BDE 153	BDE 154	BDE 183	BDE 209
4	2501-FF	0.00181	0.00181	0.00181	0.00363	0.00363	0.00544	0.00544	0.00907	0.181
5	2501-FF	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.01
6	2501-FF									0.015
9	2501-FF									
10	2501-FF									
13	2501-FF	0.00001	0.00001	0.00001	0.00003	0.00004	0.00001	0.00001	0.00001	0.00002
15	2501-FF									0.033
16	2501-FF	0.0018	0.0021	0.0016	0.0015	0.00099	0.00047	0.00057	0.0014	0.0134
17	2501-FF	0.0000142	0.0000517	0.0000668	0.0000512	0.0000391	0.000108	0.0000814	0.000105	0.0112
19	2501-FF									
28	2501-FF	0.005							0.005	0.1
37	2501-FF	0.002	0.014	0.003	0.004	0.002	0.005	0.002	0.002	0.428
40	2501-FF	0.0012	0.0013	0	0.0014	0.0013	0.002	0.0015	0.0006	0.007
41	2501-FF	0.000335	0.000335	0.000335	0.000335	0.000335	0.000335	0.000335	0.000335	
42	2501-FF								0.0014	
44	2501-FF	0.0004	0.0017	0.0004	0.0013	0.0004	0.0004	0.0004	0.0004	0.022
45	2501-FF	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
48	2501-FF	0.03	0.03		0.03	0.03	0.03	0.03	0.03	
50	2501-FF	0.00051	0.0064	0.00039	0.0018	0.0008	0.00037	0.00031	0.00012	0.037
51	2501-FF									
57	2501-FF	0.000141	0.000161		0.000241	0.000281	0.000233	0.000208	0.000116	0.0000625
58	2501-FF									
59	2501-FF	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
63	2501-FF	0.000012	0.000006	0.000012	0.000013	0.000015	0.000009	0.00001	0.000023	
65	2501-FF	0.0005	0.0004	0.0005	0.0007	0.0007	0.0006	0.0006	0.0002	0.0003
69	2501-FF								0.00274	
70	2501-FF	0.32	0.32						0.32	
71	2501-FF	0.000421	0.000268	0.000268	0.000715	0.00076	0.000727	0.000819	0.000454	0.0175
72	2501-FF	0.00025	0.002	0.002	0.00225	0.0015	0.0005	0.001	0.00025	0.05
74	2501-FF	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
75	2501-FF	0.0009	0.045	0.001	0.019	0.006	0.0003	0.001	0.001	0.05
77	2501-FF									
80	2501-FF	0.0006	0.0004	0.0005	0.0009	0.0009	0.0006	0.0007	0.0002	0.0003
86	2501-FF	0.00	0.03	0.00	0.02	0.00	0.00	0.00	0.00	0.12
90	2501-FF									0.03
75A	2501-FF	0.05		0.07					0.00	0.01



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]

EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)

Methods PBDEs - Measurement Uncertainty [%]

LC	Sample									
		BDE 28	BDE 47	BDE 49	BDE 99	BDE 100	BDE 153	BDE 154	BDE 183	BDE 209
4	2501-FF	25	25	25	25	25	25	25	30	40
5	2501-FF	22	33	31	26	24	25	22	36	24
6	2501-FF									
9	2501-FF									
10	2501-FF									
13	2501-FF									
15	2501-FF	35	25		40	40	40	40	25	50
16	2501-FF	28	21	28	15	13	27	26	22	29
17	2501-FF									
19	2501-FF									
28	2501-FF	59	42	59	59	59	59	59		
37	2501-FF	25	25	25	25	25	30	25	25	50
40	2501-FF	30	30		30	30	30	30	30	30
41	2501-FF	15	15	15	15	15	15	15	15	
42	2501-FF	50	30	50	50	30	50	50		70
44	2501-FF	30	30	30	30	30	30	30	30	50
45	2501-FF	25.3	21.3	25.8	30.2	32.1	25.7	25.3	35.3	29.6
48	2501-FF	32.5	37.7		43	48.2	42.7	70.7	43	
50	2501-FF	26.3	20	29.9	20.2	22.1	27.8	20	25.3	23
51	2501-FF									
57	2501-FF	25	25		25	25	25	25	25	25
58	2501-FF									
59	2501-FF	35	25	45	30	30	25	30	25	45
63	2501-FF									
65	2501-FF									
69	2501-FF	30	30	30	30	30	30	30	30	-
70	2501-FF	15	15		15	15	15	15	15	
71	2501-FF	67.9	20.3	20.3	17.5	19.4	20.2	23.8	9.68	31.4
72	2501-FF	48	24	23	26	23	31	24	22	45
74	2501-FF									
75	2501-FF	28	41	34	34	27	27	28	36	40
77	2501-FF									
80	2501-FF									
86	2501-FF	20	20	20	20	20	20	20	20	70
90	2501-FF	30	30	60	30	30	30	30	30	30
75A	2501-FF									

LC	Sample	Methods applied to determine		
		Limit of Quantification (LOQ)	Measurement Uncertainty (MU)	Additional Information
4	2501-FF			
5	2501-FF			
6	2501-FF			
9	2501-FF	Lowest point of validation		
10	2501-FF			
13	2501-FF			
15	2501-FF			Same method as for PBDE
16	2501-FF	LOD and LOQ were estimated based on analysis of 10 blank spiked samples	MU were estimated based on precision and truenes from fortyfication experiment	
17	2501-FF			
19	2501-FF	From analysis of the PT-sample spiked with 5 µg/kg. LOQ estimated as 10*S/N of calculated concentration	Triplicate analysis, nine days, three concentration levels (0,33; 1; 3 µg/kg) Uncerativity with contribution from bias and in-house-reproducibility	lipid content was determined with weibull-stold method (hydrolyse with 4M HCL, washing neutral, drying and soxlethextraction with Hexan)
28	2501-FF	Samples spiked at LOQ level (10 pg/g) within the batch	From validation data	
37	2501-FF	according to validation.	according to NEN 7777	
40	2501-FF			
41	2501-FF			
42	2501-FF	LOQ is the lowest calibration curve point, which can be quantified	U = k x uc where, Coverage factor k =2 is used, corresponding to a level of confidence of ~95% and, uc is combined standard uncertainty, calculated from the combination of the relative uncertainty components describing the random variations and the bias contribution	
44	2501-FF			
45	2501-FF			
48	2501-FF			
50	2501-FF			
51	2501-FF	S/N =10		
57	2501-FF			
58	2501-FF	Lowest Validated Level		
59	2501-FF	lowest spiked level meeting criteria for inter-lab precision (RSD 20%) and trueness (70-130%)	MU was calculated on the basis of fortification experiments, by summing contributions of errors from reproducibility error and deviation from theoretical (spiked) value	
63	2501-FF			
65	2501-FF			
69	2501-FF			
70	2501-FF			
71	2501-FF	LOQ = 3 x LOD; LOD evaluated as 3 times of noise		
72	2501-FF	ten point equidistant calibration in Matrix at the expected LOQ using DIN 32645		For lipid determination 4-5 g sample were used
74	2501-FF			
75	2501-FF	The LOQ was estimated following the "Calibration Standards" approach. This methodology is reported in the Guidance Document on the Estimation of LOD and LOQ for	The MU was estimated using the Top-Down approach reported in the Guidance Document on Measurement Uncertanty for Laboratories performing PCDD/F and PCB Analysis using Isotope Dilution Mass Spectrometry	
77	2501-FF	Empirically determined as the lowest calibration point producing signal above S/N 10	Established from quality control charts (2*RSD)	
80	2501-FF			
86	2501-FF			
90	2501-FF			



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]
EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)
Methods HBCDDs - Limit of detection (LOQ) in µg/kg wet weight

LC	Sample	(+/-)-α-HBCDD	(+/-)-β- HBCDD	(+/-)-γ- HBCDD	Total HBCDD (using GC-methods)
4	2501-FF	0.006	0.006	0.006	
5	2501-FF				
6	2501-FF		0.002		
9	2501-FF	0.2	0.02	0.04	
10	2501-FF	0	0.01	0.01	
13	2501-FF	0.2	0.05	0.05	
15	2501-FF				
16	2501-FF	0.006	0.005	0.005	
17	2501-FF				
19	2501-FF	0.1	0.1	0.1	
28	2501-FF	0	0.01	0.01	
37	2501-FF	0.01	0.01	0.01	
40	2501-FF				
41	2501-FF				
42	2501-FF	0.04	0.04	0.04	
44	2501-FF				
45	2501-FF				
48	2501-FF				
50	2501-FF				
51	2501-FF		0.001	0.001	
57	2501-FF				
58	2501-FF	0.03	0.03	0.03	
59	2501-FF	0.01	0.01	0.01	
63	2501-FF				
65	2501-FF				
69	2501-FF	0.02	0.02	0.02	
70	2501-FF				
71	2501-FF				
72	2501-FF		0.01	0.01	
74	2501-FF				
75	2501-FF	0.01	0.01	0.01	
77	2501-FF	0.02	0.02	0.02	
80	2501-FF				
86	2501-FF				
90	2501-FF				
75A	2501-FF		0.01	0.01	



EURL Proficiency Test on the Determination of PCDD/Fs, PCBs, PBDEs; HBCDDs and PFAS in Fish Fillet 2025 [EURL-PT-POP_2501-FF]
EURL for halogenated Persistent Organic Pollutants (POPs) in Feed and Food

Fish Fillet (2501-FF)
Methods HBCDDs - Measurement Uncertainty [%]

LC	Sample		(+/-)-α-HBCDD	(+/-)-β- HBCDD	(+/-)-γ- HBCDD
4	2501-FF		30	50	30
5	2501-FF				
6	2501-FF				
9	2501-FF				
10	2501-FF		25	30	30
13	2501-FF				
15	2501-FF				
16	2501-FF		16	32	30
17	2501-FF				
19	2501-FF		11		
28	2501-FF		36	49	49
37	2501-FF		25	41	31
40	2501-FF				
41	2501-FF				
42	2501-FF		30	30	30
44	2501-FF				
45	2501-FF				
48	2501-FF				
50	2501-FF				
51	2501-FF				
57	2501-FF				
58	2501-FF		30	30	30
59	2501-FF		30	30	30
63	2501-FF				
65	2501-FF				
69	2501-FF		23	18	16
70	2501-FF				
71	2501-FF				
72	2501-FF				
74	2501-FF				
75	2501-FF		27	30	32
77	2501-FF		21	21	21
80	2501-FF				
86	2501-FF				
90	2501-FF				
75A	2501-FF		27	30	32