Evaluation Report
proficiency test

DLA ptAU03 (2021)

Iodine and Fluorine

in Salt

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Allgemeine Informationen zur Eignungsprüfung (EP)
General Information on the proficiency test (PT)

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EP-Bericht Freigabe *PT-Report Authorization*	Dr. Matthias Besler-Scharf (Technischer Leiter / Technical Manager) *- gezeichnet / signed M. Besler-Scharf* Alexandra Scharf MSc. (QM-Beauftragte / Quality Manager) *- gezeichnet / signed A. Scharf* Datum / Date: 12 November 2021
Unteraufträge *Subcontractors*	Im Rahmen dieser Eignungsprüfung wurden nachstehende Leistungen im Unterauftrag vergeben: Keine As part of the present proficiency test the following services were subcontracted: none
Vertraulichkeit *Confidentiality*	Die Teilnehmerergebnisse sind im EP-Bericht in anonymisierter Form mit Auswertenummern benannt. Daten einzelner Teilnehmer werden ausschließlich nach vorheriger Zustimmung des Teilnehmers an Dritte weitergegeben. Participant result are named anonymously with evaluation numbers in the PT report. Data of individual participants will be passed on to third parties only with prior consent of the participant.

Contents

1. Introduction

The participation in proficiency testing (PT) schemes is an essential element of the quality-management-system of every laboratory testing food and feed, cosmetics and food contact materials. The implementation of proficiency tests enables the participating laboratories to prove their own analytical competence under realistic conditions. At the same time they receive valuable data regarding the verification and/or validation of the particular testing method [1, 5].

The purpose of DLA is to offer proficiency tests for selected parameters in concentrations with practical relevance.

Realisation and evaluation of the present proficiency test follows the technical requirements of DIN EN ISO/IEC 17043 (2010) and DIN ISO 13528:2009 / ISO 13528:2015 [2, 3].

2. Realisation

2.1 Test material

The test material is a mixture of commercially available table salts from European suppliers.
The contents of the packaging units were mixed and homogenized.

Afterwards the samples were portioned to approximately 200 g into metallised PET film bags and chronologically numbered.

The composition (list of ingredients) and the iodine and fluorine contents calculated on the basis of the declaration are given in tables 1 and 2.

Table 1: Composition of DLA-Samples

Iodized table salt with fluorine
Ingredients: Boiling salt, potassium fluoride, potassium iodate, separating agents: sodium ferrocyanide, sodium carbonates

Note: The metrological traceability of temperature, mass and volume during production of the PT samples is ensured by DAkkS calibrated reference materials.

Table 2: Calculated amounts of parameters according to the manufacturers specification

Parameter	Content per kg
Iodine	18 mg
Fluorine	248 mg

2.1.1 Homogeneity

The calculation of the **repeatability standard deviations S_r of the participants** was used as an indicator of homogeneity. It is 3.83% for iodine and 8.96% for fluorine. Thus they were similar to corresponding repeatability standard deviations of precision data of the standardized methods (e.g. ASU-Method 00.00-93 and 47.03-1, s. 3.6.2) (see Table 2) [18-19]. The repeatability standard deviations of the participants' results are given in the documentation in the statistic data (see 4.1 to 4.2).

Furthermore, the homogeneity was graphically characterized for information by the **trend line function of participants' results for chronological bottled single samples** (s. 5.2.1 Homogeneity).

In case the criterion for sufficient homogeneity of the test items is not fulfilled the impact on the target standard deviation will be verified. If necessary the evaluation of results will be done considering the standard uncertainty of the assigned value by z'-scores (s. 3.8 and 3.11) [3].

2.1.2 Stability

A water activity (a_W) of < 0.5 is an important factor to ensure the stability of dry or dried products during storage. Optimum conditions for storage is the a_W value range of 0,15 - 0,3. In this range the lowest possible degradation rate is to be expected [16].
The experience with various DLA materials shows, with comparable matrix and water activity (a_W value <0.5), good durability of the PT samples and storage stability against microbial spoilage and with regard to the content of the PT parameters.
Since the EP samples are 100% table salt, the stability of the sample material was ensured during the investigation period under the specified storage conditions.

2.2 Sample shipment and information to the test

Two portions of test material were sent to every participating laboratory in the 27th week of 2021. The testing method was optional. The tests should be finished at 03rd September 2021 the latest.

With the cover letter along with the sample shipment the following information was given to participants:

The two portions contain identical samples of iodized salt with fluorine. The analytical method for the determination of the parameters iodine and fluorine is optional.

Please note the attached information on the proficiency test.
(see documentation, section 5.3 Information on the PT)

2.3 Submission of results

The participants submitted their results in standard forms by means of transmission tables handed over to the participating laboratories (by email).

The finally calculated concentrations of the parameter as average of duplicate determinations of both numbered samples were used for the statistical evaluation. For the calculation of the repeatability- and reproducibility standard deviation the single values of the double determination were used.

Queried and documented were single results, recovery and the used testing methods. In case participants submitted several results for the same parameter obtained by different methods these results were evaluated with the same evaluation number with a letter as a suffix and indication of the related method.

All 9 participants submitted at least one result.

3. Evaluation

3.1 Consensus value from participants (assigned value)

The robust mean of the submitted results was used as assigned value (X_{pt}) („consensus value from participants"). The calculation was done according to algorithm A as described in annex C of ISO 13528 [3]. If there are < 12 quantitative results and an increased difference between robust mean and median, the median may be used as the assigned value (criterion: ∆ median - rob. mean > 0,3 σ_{pt}) [3].

The condition is that the majority of the participants' results show a normal distribution or are distributed unimodal and symmetrically. To this end, an examination of the distribution is carried out, inter alia, using the kernel density estimate [3, 12].

In case there are indications for sources of higher variability such as a bimodal distribution of results, a cause analysis is performed. The use of different examination methods is often an option. If this is the case, separate evaluations with own assigned values (X_{pti}) are made whenever possible.

The statistical evaluation is carried out for all the parameters for a minimum of 7 values are present, in justified cases, an evaluation may also be carried out from 5 results onwards.

The actual measurement results will be drafted. Individual results, which are outside the specified measurement range of the participating laboratory (for example with the result > 25 mg/kg or < 2,5 mg/kg) or the indicating "0" will not be considered for the statistic evaluation [3].

3.2 Robust standard deviation

For comparison to the target standard deviation σ_{pt} (standard deviation for proficiency assessment) a robust standard deviation (S*) of the submitted results was calculated. The calculation was done according to algorithm A as described in annex C of ISO 13528 [3].

3.3 Repeatability standard deviation

The repeatability standard deviation S_r is based on the laboratory´s standard deviation of (outlier free) individual participant results, each under repeatability conditions, that means analyses was performed on the same sample by the same operator using the same equipment in the same laboratory within a short time. It characterizes the mean deviation of the results within the laboratories [3] and is used by DLA as an indication of the homogeneity of the sample material.

In case single results from participants are available the calculation of the repeatability standard deviation S_r, also known as standard deviation within laboratories S_w, is performed by: [3, 4].

The relative repeatability standard deviation as a percentage of the mean value is indicated as coefficient of variation CV_r in the table of statistical characteristics in the results section in case single results from participants are available.

3.4 Reproducibility standard deviation

The reproducibility standard deviation S_R represents a inter-laboratory estimate of the standard deviation for the determination of each parameter on the bases of (outlier free) individual participant results. It takes into account both the repeatability standard deviation S_r and the within-laboratory standard deviation S_S. Reproducibility standard deviations of PT´s may differ from reproducibility standard deviations of ring trials, because the participating laboratories of a PT generally use different internal conditions and methods for determining the measured values. In the present evaluation, the specification of the reproducibility standard deviation, therefore, does not refer to a specific method, but characterizes approximately the comparability of results between the laboratories, assumed the effect of homogeneity and stability of the sample are negligible.
In case single results from participants are available the calculation of the reproducibility standard deviation S_R is performed by: [3, 4].

The relative reproducibility standard deviation in percent of the mean is given as variation coefficient CV_R in the statistical data of participant for each parameter if the single results from participants are available. The significance of CV_R is further explained in section 3.9.

3.5 Exclusion of results and outliers

Before statistical evaluation obvious blunders, such as those with incorrect units, decimal point errors, too few significant digits (valid digits) or results for another proficiency test item can be removed from the data set [2]. Even if a result e.g. with a factor >10 deviates significantly from the mean and has an influence on the robust statistics, a result of the statistical evaluation can be excluded [3].

All results should be given at least with 2 significant digits. Specifying 3 significant digits is usually sufficient.

Results obtained by different analytical methods causing an increased variability and/or a bi- or multimodal distribution of results, are treated separately or could be excluded in case of too few numbers of results. For this results are checked by kernel density estimation [3, 12].

Results are tested for outliers by the use of robust statistics (algorithm A): If a value deviates from the robust mean by more than 3 times the robust standard deviation, it can be classified as an outlier (see above) [3]. Due to the use of robust statistics outliers are not excluded, provided that no other reasons are present [3]. Detected outliers are only mentioned in the results section, if they have been excluded from the statistical evaluation.

3.6 Target standard deviation (for proficiency assessment)

The target standard deviation of the assigned value σ_{pt} (= standard deviation for proficiency assessment) can be determined according to the following methods.

If an acceptable quotient $S*/\sigma_{pt}$ is present, the target standard deviation of the general model by Horwitz is preferably used for the proficiency assessment. It is usually suitable for evaluation of interlaboratory studies, where different methods are applied by the participants. On the other hand the target standard deviation from the evaluation of precision data of an precision experiment is derived from collaborative studies with specified analytical methods.

In cases where both above-mentioned models are not suitable, the target standard deviation is determined based on values by perception, see under 3.6.3.

For information, the z-scores of both models are given in the evaluation, if available.

In the present PT for valuation of the <u>parameters fluorine and iodine</u> the target standard deviation according to the general model of Horwitz was applied (see 3.6.1).

3.6.1 General model (Horwitz)

Based on statistical characteristics obtained in numerous PTs for different parameters and methods Horwitz has derived a general model for estimating the reproducibility standard deviation σ_R [6]. Later the model was modified by Thompson for certain concentration ranges [10]. The reproducibility standard deviation σ_R can be applied as the relative target standard deviation σ_{pt} in % of the assigned values and calculated according to the following equations [3]. For this the assigned value X_{pt} is used for the concentration c.

Equations	Range of concentrations	corresponds to
$\sigma_R = 0{,}22c$	$c < 1{,}2 \times 10^{-7}$	< 120 µg/kg
$\sigma_R = 0{,}02c^{0{,}8495}$	$1{,}2 \times 10^{-7} \leq c \leq 0{,}138$	≥ 120 µg/kg
$\sigma_R = 0{,}01c^{0{,}5}$	$c > 0{,}138$	$> 13{,}8$ g/100g

with c = mass content of analyte (as relative size, e.g. 1 mg/kg = 1 ppm = 10^{-6} kg/kg)

3.6.2 Value by precision experiment

Using the reproducibility standard deviation σ_R and the repeatability standard deviation σ_r of a precision experiment (collaborative trial or proficiency test) the target standard deviation σ_{pt} can be derived considering the number of replicate measurements m of participants in the present PT [3]:

$$\sigma_{pt} = \sqrt{\sigma_R^2 - \sigma_r^2 \left(m-1 \,/\, m \right)}$$

The relative repeatability standard deviations (RSD$_r$) and relative reproducibility standard deviation (RSD$_R$) given in Table 2 were determined in ring tests using the indicated methods.
The resulting target standard deviations σ_{pt}, which were identified there, were used to evaluate the results and to provide additional information for the statistical data.

Table 2: Relative repeatability standard deviations (RSD$_r$) and relative reproducibility standard deviations (RSD$_R$) according to selected evaluations of tests for precision and the resulting target standard deviation σ_{pt} [18-19]

Parameter	Matrix	Mean (mg/kg)	RSD$_r$ (%)	RSD$_R$ (%)	σ_{pt} (%)	Method / Literature
Iodine	Cod meat	4,15	0,7	8,9	8,89	ICP-MS/ [18] ASU 00.00-93
Iodine	Iodized salz	19,8	6,4	15	14,3[1]	ICP-MS/ [18] ASU 00.00-93
Iodine	Seaweed	40,1	0,9	6,2	6,17	ICP-MS/ [18] ASU 00.00-93
Fluorine	Tea	150	1,76	4,69	4,52	Potentiometrisch/[19] ASU 47.03-1
Fluorine	Tea	113	1,65	9,15	9,08	Potentiometrisch/[19] ASU 47.03-1
Fluorine	Tea	152	1,98	6,14	5,98[1]	Potentiometrisch/[19] ASU 47.03-1

[1] *values used for evaluation (s. chapter 4)*

3.6.3 Value by perception

The target standard deviation for proficiency assessment can be set at a value that corresponds to the level of performance that the coordinator would wish laboratories to be able to achieve [3].

For the present evaluation the target standard deviation according to 3.6.1 was regarded suitable.

Table 3 shows selected statistic data of participants' results of present PT compared to PT results of previous years.

Tabelle 3: Characteristics of the present PT (on dark grey) in comparison to the previous PT from 2017 and 2019 (SD = standard deviation, CV = coefficient of variation)

Parameter	Matrix (Powder)	robust Mean	rob. SD (S*)	rel. SD (CV$_{s*}$) [%]	Quotient S*/σpt	DLA-report
Iodine	Table salt	18,5	2,60	14,1	1,0	DLA 31/2017
Iodine	Table salt	23,2	2,72	11,7	0,82	DLA 31/2019
Iodine	Table salt	18,3	2,62	14,3	1,4	DLA ptAU03 (2021)
Fluorine	Table salt	200	41,9	21,0	1,8*	DLA 31/2017
Fluorine	Table salt	314	65,9	21,0	2,0*	DLA 31/2019
Fluorine	Table salt	217	7,22	3,32	0,47	DLA ptAU03 (2021)

* with target standard deviation σpt'

3.7 z-Score

To assess the results of the participants the z-score is used. It indicates about which multiple of the target standard deviation (σ_{pt}) the result (x_i) of the participant is deviating from the assigned value (X_{pt}) [3].
Participants' z-scores are derived from:

$$z_i = \frac{\left(x_i - x_{pt}\right)}{\sigma_{pt}}$$

The requirements for the analytical performance are generally considered as fulfilled if

$$-2 \leq z \leq 2 \ .$$

The valid z-Score for each parameter is indicated as z-Score (σ_{pt}). The value indicated as z-Score (Info) only obtains an informative character. The both z-Scores were calculated with the different target standard deviations in accordance with 3.6.

3.7.1 Warning and action signals

In accordance with the norm ISO 13528 it is recommended that a result that gives rise to a z-score above 3,0 or below −3,0, shall be considered to give an "action signal" [3]. Likewise, a z-score above 2,0 or below −2,0 shall be considered to give a "warning signal". A single "action signal", or "warning signal" in two successive PT-rounds, shall be taken as evidence that an anomaly has occurred which requires investigation. An error or cause analysis can be carried out by checking the analysis process including understanding and implementation of the measurement by the staff, details of the measurement procedure, calibration of equipment and composition of reagents, transmission error or an error in the calculation, in the trueness and precision and use of reference material. If necessary, the problems must be addressed through appropriate corrective action [3].

In the figures of z-scores DLA gives the limits of warning and action signals as yellow and red lines respectively. According to ISO 13528 the signals are valid only in case of a number of ≥ 10 results [3].

3.8 z'-Score

The z'-score can be used inter alia for the valuation of the results of the participants, in cases the standard uncertainty has to be considered (s. 3.11). The z'-score represents the relation of the deviation of the result (x_i) of the participant from the respective consensus value (X_{pt}) to the square root of quadrat sum of the target standard deviation (σ_{pt}) and the standard uncertainty ($U_{(Xpt)}$) [3].

The calculation is performed by:

$$z'_i = \frac{x_i - x_{pt}}{\sqrt{\sigma^2_{pt} + u^2_{(x_{pt})}}}$$

If carried out an evaluation of the results by means of z 'score, we have defined below the expression in the denominator as a target standard deviation σ_{pt}'.

The requirements for the analytical performance are generally considered as fulfilled if

$$-2 \leq z' \leq 2 \ .$$

For warning and action signals see 3.7.1.

3.9 Reproducibility coefficient of variation (VK$_R$)

The variation coefficient (CV$_R$) of the reproducibility (= *relative repro-
ducibility standard deviation*) is calculated from the reproducibility
standard deviation S$_R$ and the mean as follows [4, 13]:

$$CV_R = \frac{S_R * 100}{X}$$

In contrast to the standard deviation as a measure of the absolute varia-
bility the CV$_R$ gives the relative variability within a data region. While
a low CV$_R$, e.g. <5-10% can be taken as evidence for a homogeneous set of
results, a CV$_R$ of more than 50% indicates a "strong inhomogeneity of
statistical mass", so that the suitability for certain applications such
as the assessment of exceeded maximum levels or the performance evalu-
ation of the participating laboratories possibly can not be done [3].

3.10 Quotient S*/σpt

Following the HorRat-value the results of a proficiency-test (PT) can be
considered convincing, if the quotient of robust standard deviation S*
and target standard deviation σpt does not exceed the value of 2.
A value > 2 means an insufficient precision, i.e. the analytical method
is too variable, or the variation between the test participants is higher
than estimated. Thus the comparability of the results is not given [3].

3.11 Standard uncertainty of the assigned value

Every assigned value has a standard uncertainty that depends on the ana-
lytical method, differences between the analytical methods used, the test
material, the number of participating laboratories (P) and on other
factors. The standard uncertainty ($U_{(Xpt)}$) for this PT is calculated as
follows [3]:

$$u_{(x_{pt})} = 1{,}25 \times \frac{s^*}{\sqrt{p}}$$

If $U_{(Xpt)} \leq 0{,}3$ σpt the standard uncertainty of the assigned value needs
not to be included in the interpretation of the results of the PT [3].
Values exceeding 0,3 imply, that the target standard deviation could be
too low with respect to the standard uncertainty of the assigned value.

The traceability of the assigned value is ensured on the basis of the
consensus value as a robust mean of the participant results.

4. Results

All following tables are anonymized. With the delivering of the evaluation report the participants are informed about their individual evaluation number.

In the first table the characteristics are listed:

Statistic Data
Number of results
Number of outliers
Mean
Median
Robust mean(X_{pt})
Robust standard deviation **(S*)**
Number with m replicate measurements
Repeatability standard deviation (S_r)
Coefficient of Variation (CV_r)in %
Reproducibility standard deviation (S_R)
Coefficient of Variation (CV_R)in %
Target range:
Target standard deviation σ_{pt} or σ_{pt}'
Target standard deviation for information
lower limit of target range ($X_{pt} - 2\sigma_{pt}$) or ($X_{pt} - 2\sigma_{pt}$') *
upper limit of target range ($X_{pt} + 2\sigma_{pt}$) or ($X_{pt} + 2\sigma_{pt}$´) *
Quotient S*/σ_{pt} or S*/σ_{pt}'
Standard uncertainty U(X_{pt})
Number of results in the target range
Percent in the target range

* Target range is calculated with z-score or z'-score

In the table below, the results of the participating laboratories are formatted in 3 valid digits**:

Auswerte-nummer	Parameter	Abweichung	z-Score	z-Score	Hinweis
Evaluation number	[Einheit / Unit]	Deviation	σpt	(Info)	Remark

*** In the documentation part, the results are given as they were transmitted by the participants.*

4.1 Iodine in mg/kg

Vergleichsuntersuchung / Proficiency Test

Statistic Data	
Number of results	9
Number of outliers	0
Mean	18,3
Median	18,0
Robust Mean (X)	**18,3**
Robust standard deviation (S*)	**2,62**
Number with 2 replicates	8
Repeatability SD (S$_r$)	0,711
Repeatability (CV$_r$)	3,83%
Reproducibility SD (S$_R$)	2,39
Reproducibility (CV$_R$)	12,9%
Target range:	
Target standard deviation σ_{pt}	**1,89**
Target standard deviation (for Information)	2,62
lower limit of target range	**14,5**
upper limit of target range	**22,1**
Quotient S*/σ_{pt}	*1,4*
Standard uncertainty U$_{(Xpt)}$	*1,09*
Quotient U$_{(Xpt)}$/σ_{pt}	*0,58*
Results in the target range	*9*
Percent in the target range	*100%*

Comments:

The target standard deviation was calculated according to the general model of Horwitz (s. 3.6.1). Additionally the target standard deviation using data from precision experiments (ASU §64 L 00.00-93) is given for information.

The distribution of results showed a normal variability. The quotient S*/σ_{pt} was below 2.0. The robust standard deviation was in the range of previous PTs (see 3.6.3). The comparability of results is given.

The repeatability and reproducibility standard deviation were in the range of of established values for the used determination methods (s. 3.6.2).
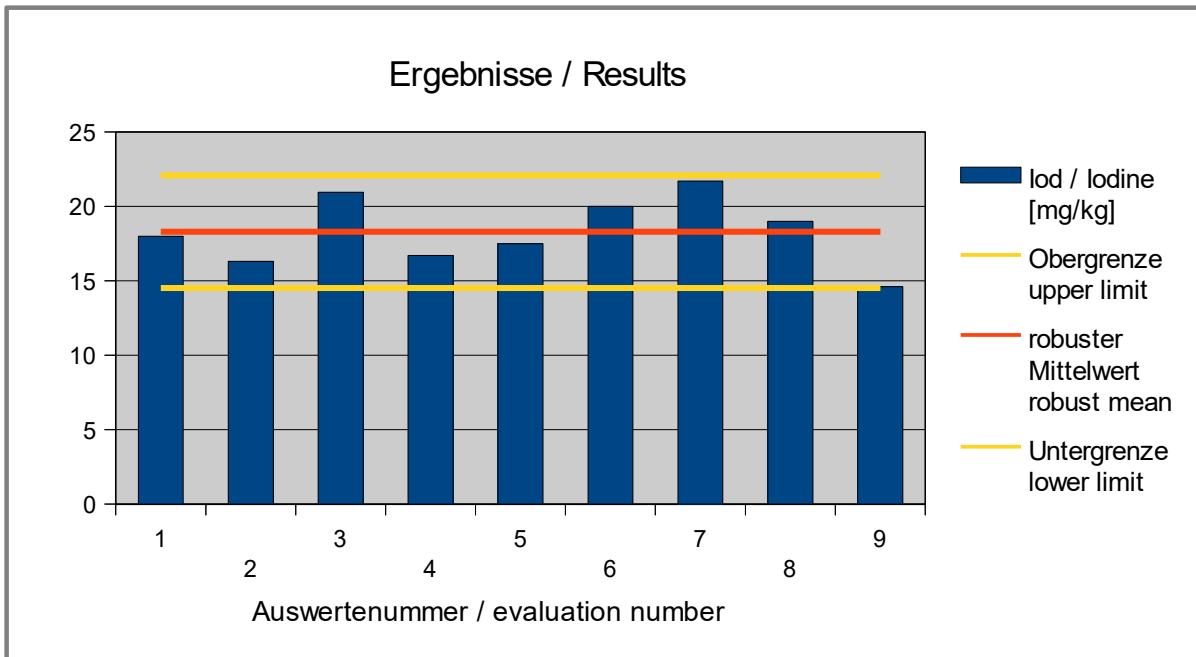
100% of results were in the target range.
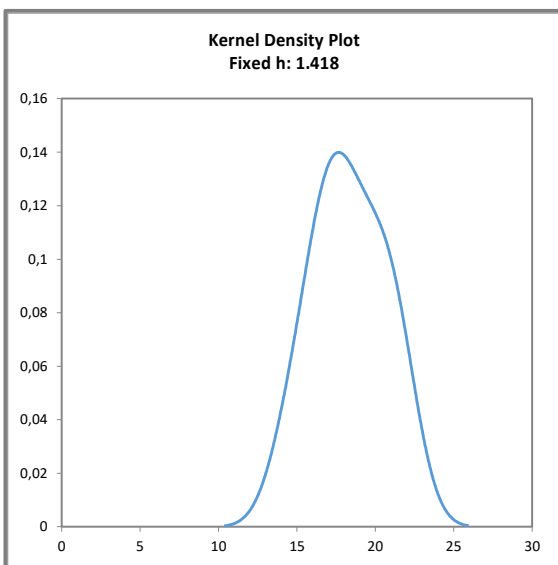
Abb. / Fig. 1: Ergebnisse Iod **/** Results Iodine

Abb. / Fig. 2:
Kerndichte-Schätzung der Ergebnisse
(mit h = 0,75 x σ_{pt} von X_{pt})

Kernel density plot of results
(with h = 0,75 x σ_{pt} of X_{pt})

Comment:
The kernel density shows an approximately symmetrical distribution of results with a small shoulder.

Ergebnisse der Teilnehmer:
Results of Participants:

Auswerte-nummer Evaluation number	Iod / Iodine [mg/kg]		Abweichung [mg/kg] Deviation [mg/kg]	z-Score (σ_{pt})	z-Score (Info)	Hinweis Remark
1	18,0		−0,308	−0,16	−0,12	
2	16,3	*	−1,998	−1,1	−0,76	
3	21,0	*	2,642	1,4	1,0	
4	16,7		−1,608	−0,85	−0,61	
5	17,5		−0,808	−0,43	−0,31	
6	20,0		1,692	0,89	0,65	
7	21,7		3,392	1,8	1,3	
8	19,0		0,692	0,37	0,26	
9	14,6		−3,698	−2,0	−1,4	

* Mean calculated by DLA
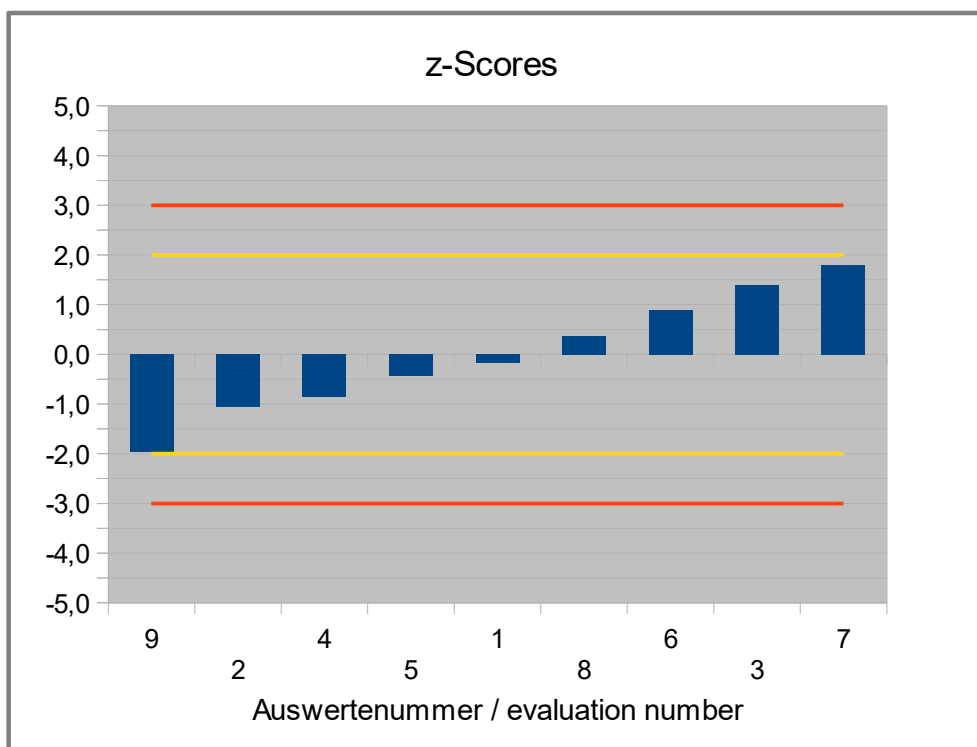
Abb. / Fig. 3: z-Scores Iod / Iodine

4.2 Fluorine in mg/kg

Vergleichsuntersuchung / Proficiency Test

Statistic Data	
Number of results	8
Number of outliers	0
Mean	217
Median	219
Robust Mean (X)	**217**
Robust standard deviation (S*)	**7,22**
Number with 2 replicates	7
Repeatability SD (S_r)	19,5
Repeatability (CV_r)	8,96%
Reproducibility SD (S_R)	–
Reproducibility (CV_R)	–
Target range:	
Target standard deviation σ_{pt}	**15,5**
Target standard deviation (for Information)	13,0
lower limit of target range	**186**
upper limit of target range	**248**
Quotient S/σ_{pt}*	*0,47*
Standard uncertainty $U_{(Xpt)}$	*3,19*
Quotient $U_{(Xpt)}$/σ_{pt}	*0,21*
Results in the target range	*8*
Percent in the target range	*100%*

Comments:

The target standard deviation was calculated according to the general model of Horwitz (s. 3.6.1). Additionally the target standard deviation using data from precision experiments (ASU §64 L 00.00-93) is given for information.

The distribution of results showed a low variability. The quotient S/σ_{pt} was below 1.0. The robust standard deviation was in the range of previous PTs (see 3.6.3). The comparability of results is given.*

The repeatability standard deviation was in the range of established values for the used determination methods (s. 3.6.2).

100% of results were in the target range.

Ergebnisse / Results
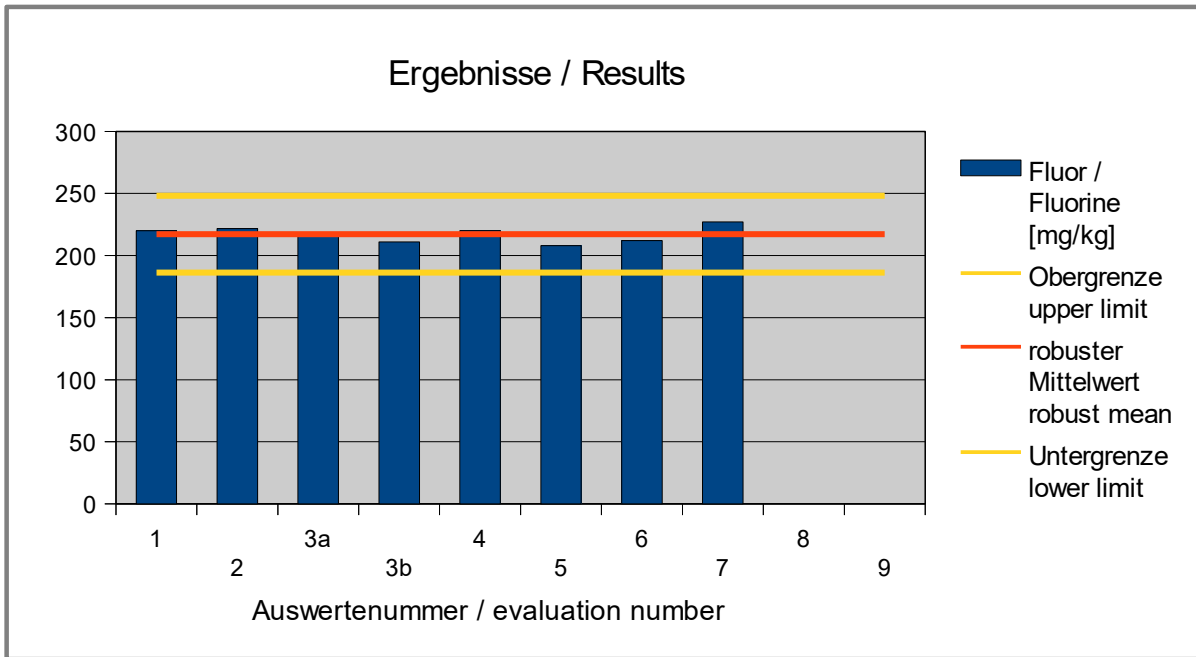
Abb. / Fig. 4: Ergebnisse Fluor **/** Results Fluorine

Legend:
- Fluor / Fluorine [mg/kg]
- Obergrenze upper limit
- robuster Mittelwert robust mean
- Untergrenze lower limit

X-axis: Auswertenummer / evaluation number (1, 2, 3a, 3b, 4, 5, 6, 7, 8, 9)

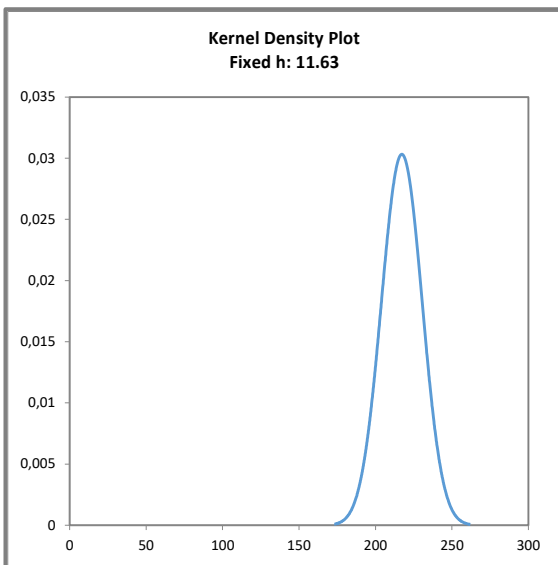**Kernel Density Plot**
Fixed h: 11.63

Abb. / Fig. 5:
Kerndichte-Schätzung der Ergebnisse
(mit h = 0,75 x σ_{pt} von X_{pt})

Kernel density plot of results
(with h = 0,75 x σ_{pt} of X_{pt})

Comment:
The kernel density showed an approximately symmetrical distribution of the results.

Ergebnisse der Teilnehmer:
Results of Participants:

Auswerte- nummer / Evaluation number	Fluor / Fluorine [mg/kg]		Abweichung [mg/kg] Deviation [mg/kg]	z-Score (σ_{pt})	z-Score (Info)	Hinweis Remark
1	220		2,8	0,18	0,22	
2	222		4,6	0,30	0,36	
3a	218		0,5	0,03	0,04	
3b	211	*	−6,2	−0,40	−0,48	
4	220	*	2,8	0,18	0,22	
5	208		−9,2	−0,59	−0,71	
6	212		−5,2	−0,34	−0,40	
7	227		9,8	0,63	0,76	
8						
9						

* Mean calculated by DLA
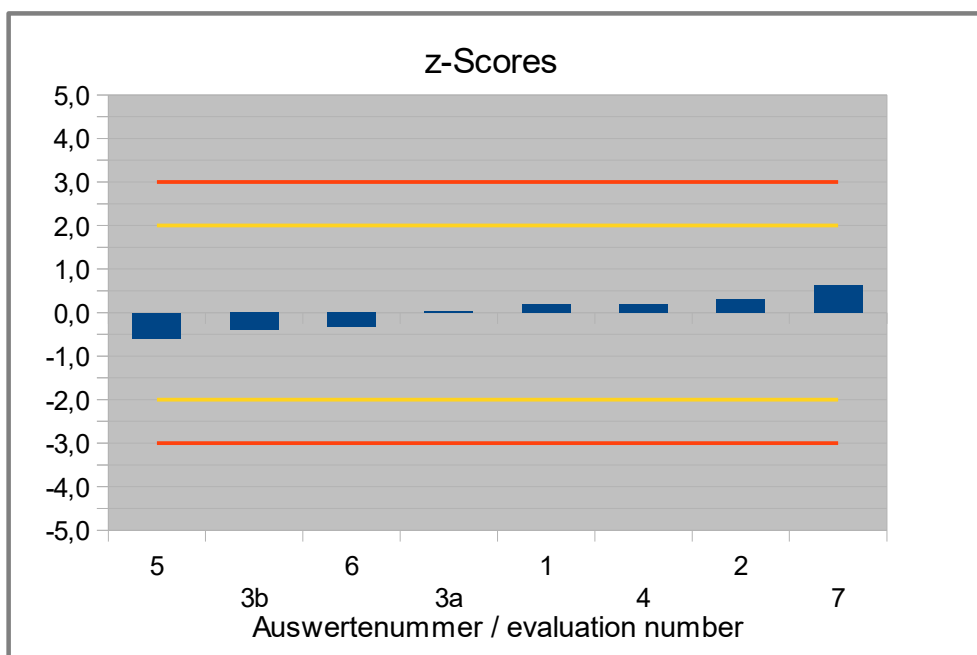
Abb. / Fig. 6: z-Scores Fluor / fluorine

4.3 Partcipants' z-Scores: Overview table

Evaluation number	Iodine	Fluorine
1	-0,16	0,18
2	-1,1	0,30
3/3a	1,4	0,03
3b		-0,40
4	-0,85	0,18
5	-0,43	-0,59
6	0,89	-0,34
7	1,8	0,63
8	0,37	
9	-2,0	

Bewertung des z-Scores / valuation of z-score (DIN ISO 13528:2009-01):
-2 ≤ z-score ≤ 2 erfolgreich / successful (in green)
-2 > z-score > 2 „Warnsignal" / warning signal (in yellow)
-3 > z-score > 3 „Eingriffssignal" / action signal (in red)

5. Documentation

Note: Information given in German were translated by DLA to the best of our knowledge (without guarantee of correctness).

5.1 Details by the participants
5.1.1 Primary data

Parameter	Partici-pant	Unit	Sample I DLA No.	Sample II DLA No.	Date of analysis	Result (Mean)	Result I	Result II	Limit of quantifica-tion	Incl. RR	Recovery rate	Method description as in test report / norm / literature
					Day/Month					yes / no	in %	
lod / Iodine	1	mg/kg	4	18	29/07 & 03/08	18	18	18	0,4	no	103	Titrimetry (in-house method)
	2	mg/kg	8	----	03. Aug	17,1	16.89 17.31	----	----	NO	----	MET-CENAN-DECYTA-015 Quantitative determination of iodine in salt. Ed. N°09.2020
	2	mg/kg	----	14	03. Aug	15,52	----	15.41 15.63		NO	----	MET-CENAN-DECYTA-015 Quantitative determination of iodine in salt. Ed. N°09.2020
	3	mg/kg	3	19	26.08.		20,2	21,7	0,3 mg/kg	yes	107	ASU L 00.00-93
	4	mg/kg	5	17	Aug 21	16,7	16,5	17				Titrimetry
	5	mg/kg	9	13	Aug 21	17,5	17	18				Titrimetry
	6	mg/kg	2	20	06.08.	20	19,3	20,6	3	no		Titrimetric according to TGL 21820/05
	7	mg/kg	DLA ptAU03-2021	DLA ptAU03-2021	23.08.2021	21,7	22,6	20,9		no		Iodate using potentiometric titration
	8	mg/kg	7	15	31. Aug	19	19	19	1	yes	102	UNI EN 15111:2007
	9	mg/kg	6	16	15. Jul	14,61	14,58	14,63	1	no	100	SLMB 1064

Parameter	Partici-pant	Unit	Sample I DLA No.	Sample II DLA No.	Date of analysis	Result (Mean)	Result I	Result II	Limit of quantifica-tion	Incl. RR	Recovery rate	Method description as in test report / norm / literature
					Day/Month					Yes / no	in %	
Fluor / Fluorine	1	mg/kg	4	18	04&05/08	220	210	230	50	no	98	Potentiometry (§ 64 LFGB ASU L 49.00-7, mo-dified)
	2	mg/kg	8	----	04. Aug	231,06	230.71 231.41	----	----	NO	----	MET-CENAN-DECYTA-017 Determination of fluorine in salt and water. Potentiometric selec-tive ion method. Ed. N° 03.2020
	2	mg/kg	----	14	04. Aug	212,58	----	212.25 212.91		NO	----	MET-CENAN-DECYTA-017 Determination of fluorine in salt and water. Potentiometric selec-tive ion method. Ed. N° 03.2020
	3a	mg/kg	3	19	27.07.		192,1	243,2		no	86.5	ASU L59.11-18
	3b	mg/kg	3	19	27.07.		188	234		no	89,5	Determination of anions and organic acids using IC in food
	4	mg/kg	5	17	Aug 21	220	227	214		no		In-house method GC-FID
	5	mg/kg	9	13	Aug 21	208	207	208		no		In-house method GC-FID
	6	mg/kg	2	20	05.08.	212	224	119	10	no	100,3	ASU § 64 LFGB, L59.11-18; Nov. 1986
	7	mg/kg	DLA ptAU03-2021	DLA ptAU03-2021	24.08.2021	227	229	225	31	no		Fluoride using an ion-sensitive electrode
	8	mg/kg										
	9	mg/kg										

5.1.2 Analytical Methods

Parame-ter	Parti-cipant	Sample preparation and proces-sing	Measuring me-thod	Calibration / Reference material	Recovery rate with same matrix	Method accredited ISO/IEC 17025	Further Remarks
					yes / no	yes / no	
Iod / Iodine	1	Grinding	iodometric titration	DLA 31/2017	yes	yes	
	2	Sample dissolved in water	Volumetric	Internal control sample	no	yes	The sample change the color before the titration, when KI is added.
	2	Sample dissolved in water	Volumetric	Internal control sample	no	yes	The sample change the color before the titration, when KI is added.
	3	0,5g/25ml TMAH, 1:5 diluted = measuring solution	ICP-MS	I-Std 1000 mg/l from Merck	no, with diverse reference materials	yes	
	4	Sample was completely ground					
	5	Sample was completely ground					
	6					yes	See * * Iodine was determined by titration. Due to the high content of water-insoluble substances, the transition point could not be clearly determined.
	7		determined as iodate				Result given as iodate, not converted to iodine
	8	mineralisation	ICP-MS	Calibration with MRC sigma aldrich product n. 41271	no	yes	-
	9		volumetric		yes	yes	

Parame-ter	Parti-cipant	Sample preparation and proces-sing	Measuring me-thod	Calibration / Reference material	Recovery rate with same matrix	Method accredited ISO/IEC 17025	Further Remarks
					yes / no	yes / no	
Fluor / Fluorine	1	Grinding	Ion-selective elec-trode	DLA 31/2017	yes	yes	
	2	Sample dissolved in water	Selective ion	Internal control sample	no	no	
	2	Sample dissolved in water	Selective ion	Internal control sample	no	no	
	3a	50 g of salt dissolved in 500 ml; Diluti-on 1:10 = measuring solution	Measurement with fluoride – ion-sen-sitive electrode	Certipur fluoride standard solution 1000 mg / l F from Merck	yes	yes	
	3b	(50 g of salt dissolved in 500 ml + 1:10 dilution + purification with On Guard Ag/H-cartridges) = measuring solution; (5 g salt dissolved in 500 ml + + purifi-cation with On Guard Ag/H-cartridges) = measuring solution	IC-LF	TraceCert fluoride standard solution 1000 mg / l F from Sigma-Aldrich	yes, with a table salt wi-thout fluoride addition	yes	
	4	Sample was completely ground; Silylation with TECS and extraction with cyclohexane	GC-FID with ISTD Xylol			yes	
	5	Sample was completely ground; Silylation with TECS and extraction with cyclohexane	GC-FID with ISTD Xylol			yes	
	6				no	yes	
	7		determined as fluo-ride				
	8						
	9						

5.2 Homogeneity

5.2.1 Trend line function of the participants results

By comparison of the increasing sample numbers and the measurement res-
ults of participants, the homogeneity of the chronological bottled PT
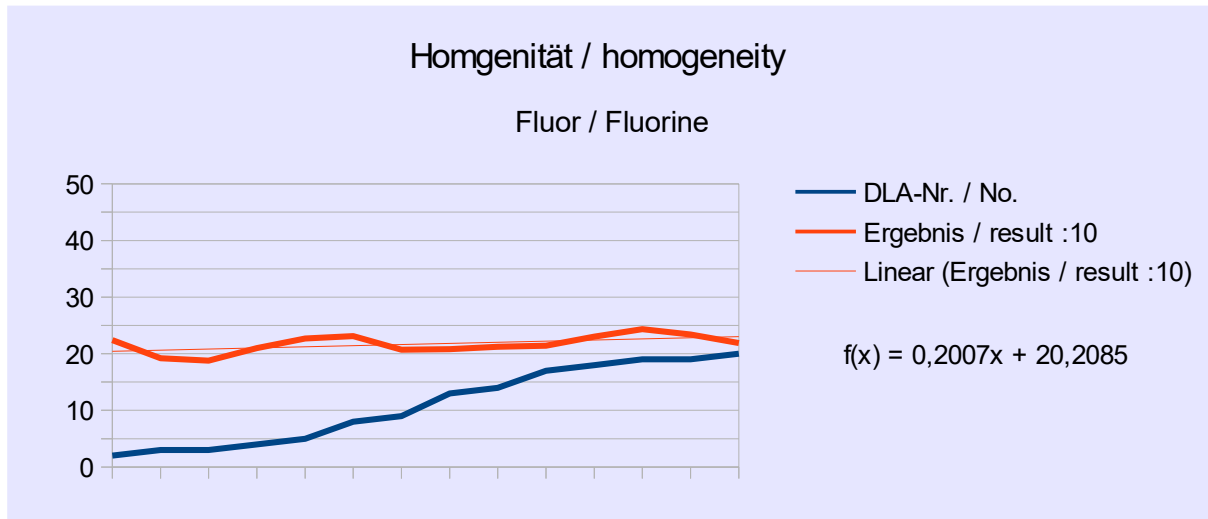items can be shown by the trend line for information:

Abb./Fig. 7:
Trendfunktion Probennummern vs. Fluor Ergebnisse (1/10 dargestellt)
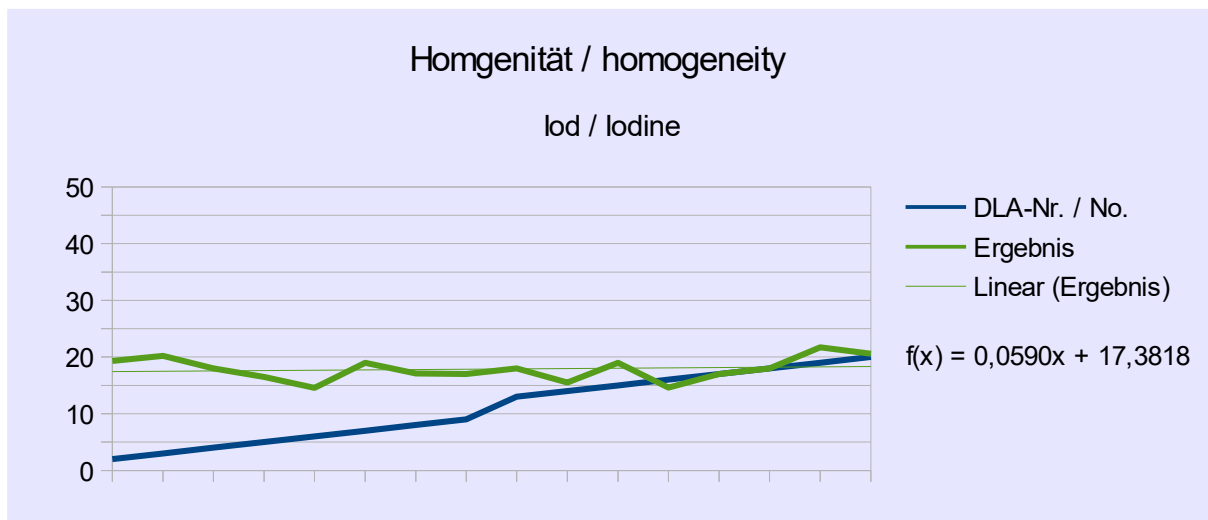trend line function sample number vs. fluorine results (1/10 shown)

Abb./Fig. 8:
Trendfunktion Probennummern vs. Iod Ergebnisse
trend line function sample number vs. iodine results

5.3 Sample cover letter: Information on the Proficiency Test (PT)

Before the PT the participants received the following information in the sample cover letter:

PT number	**DLA ptAU03 - 2021**
PT name	**Iodine and Fluorine in Salt**
Sample matrix*	**Samples I + II:** Iodine salt with fluoride / Ingredients: boiling salt, potassium fluoride, potassium iodate, separating agents: sodium ferrocyanid, sodium carbonates
Number of samples and sample amount	2 identical samples I + II, 200 g each
Storage	Samples I + II: **room temperature**
Intentional use	Laboratory use only (quality control samples)
Parameter	quantitative: **Iodine and Fluorine**
Methods of analysis	Analytical methods are optional
Notes to analysis	The analysis of PT samples should be performed like a routine laboratory analysis. In general we recommend to homogenize a representative sample amount before analysis according to good laboratory practice, especially in case of low sample weights.
Result sheet	The results for sample I and II as well as the final results calculated as mean of the double determination (samples I and II) should be filled in the result submission file. The recovery rates, if carried out, has to be included in the calculation.
Units	mg/kg
Number of significant digits	at least 2
Further information	For information please specify: – Date of analysis – DLA-sample-numbers (for sample I and II) – Limit of detection – Assignment incl. Recovery – Recovery with the same matrix – Method is accredited
Result submission	The result submission file should be sent by e-mail to: **pt@dla-lvu.de**
Deadline	**the latest 03rd September 2021.**
Evaluation report	The evaluation report is expected to be completed 6 weeks after deadline of result submission and sent as PDF file by e-mail.

* Control of mixture homogeneity and qualitative testings are carried out by DLA. Any testing of the content, homogeneity and stability of PT parameters is subcontracted by DLA.

6. Index of participant laboratories in alphabetical order

Teilnehmer / Participant	Ort / Town	Land / Country
		PERU
		Germany
		Germany
		ITALIEN
		Germany
		Germany
		Germany
		ÖSTERREICH
		Germany

[Die Adressdaten der Teilnehmer wurden für die allgemeine Veröffentlichung des Auswerte-Berichts nicht angegeben.]

[The address data of the participants were deleted for publication of the evaluation report.]

7. Index of references

1. DIN EN ISO/IEC 17025:2005; Allgemeine Anforderungen an die Kompetenz von Prüf- und Kalibrierlaboratorien / General requirements for the competence of testing and calibration laboratories
2. DIN EN ISO/IEC 17043:2010; Konformitätsbewertung – Allgemeine Anforderungen an Eignungsprüfungen / Conformity assessment – General requirements for proficiency testing
3. ISO 13528:2015 & DIN ISO 13528:2009; Statistische Verfahren für Eignungsprüfungen durch Ringversuche / Statistical methods for use in proficiency testing by inter-laboratory comparisons
4. ASU §64 LFGB: Planung und statistische Auswertung von Ringversuchen zur Methoden-validierung / DIN ISO 5725 series part 1, 2 and 6 Accuracy (trueness and precision) of measurement methods and results
5. Verordnung / Regulation 882/2004/EU; Verordnung über über amtliche Kontrollen zur Überprüfung der Einhaltung des Lebensmittel- und Futtermittelrechts sowie der Bestimmungen über Tiergesundheit und Tierschutz / Regulation on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules
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16. Homogeneity and stability of reference materials; Linsinger et al.; Accred Qual Assur, 6, 20-25 (2001)
17. AOAC Official Methods of Analysis: Guidelines for Standard Method Performance Requirements, Appendix F, p. 2, AOAC Int (2016)
18. ASU § 64 LFGB L 00.00-93 Bestimmung von Iod in Lebensmitteln, ICP-MS-Verfahren (Dezember 2008) [Determination of iodine in foods, ICP-MS method]
19. ASU § 64 LFGB L 47.03-1 Untersuchung von Tee, Bestimmung des Fluoridgehaltes, Potentiometrisches Verfahren (September 1997) [Analysis of tea, determination of the fluorine content, potentiometric method]
20. ASU § 64 LFGB L 49.00-7 Bestimmung von Fluorid in diätetischen Lebensmitteln, ionensensitive Elektrode (Juli 2000) [Determination of fluoride in dietetic foods, ion-sensitive electrode]
21. Schweizer Lebensmittel-Buch, Kochsalz 07 Jodid-Bestimmung (titrimetrisch) [Swiss Book of Foodstuffs, boiling salt 07 determination of iodine, titration]
22. Schweizer Lebensmittel-Buch, Kochsalz 08 Fluorid-Bestimmung (photometrisch)[Swiss Book of Foodstuffs, boiling salt 08 determination of fluoride, photometric]
23. Schweizer Lebensmittel-Buch, Kochsalz 09 Fluorid-Bestimmung (elektrometrisch) [Swiss Book of Foodstuffs, boiling salt 09 determination of fluoride, electrometric]