

Food Microbiology

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Edition

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Proficiency Testing
Microbiology – Food
January 2015



Quantitative analyses

- Aerobic microorganisms, 30 °C
- Enterobacteriaceae
- Thermotolerant campylobacter
- *Listeria monocytogenes*

Qualitative analyses

- Thermotolerant campylobacter
- *Listeria monocytogenes*
- *Salmonella*
- *Escherichia coli* O157
- Pathogenic *Vibrio* spp.
- *Yersinia enterocolitica*

Abbreviations

Media

| | |
|---------|--|
| ALOA | Agar Listeria Ottaviani & Agosti |
| APW 2% | Alcaline peptone water, 2 % NaCl |
| BriS | Brilliance Salmonella-agar |
| BPW | Buffered peptone water |
| CIN | Cefsulodin-irgasan-novobiocin-agar |
| CT-SMAC | Cefixime-tellurite-sorbitol-MacConkey-agar |
| LMBA | Listeria monocytogenes Blood-agar |
| MPCA | Milk Plate Count Agar |
| MRB | Modified Rappaport broth |
| mTSB | Modified Tryptone soya broth |
| PSB | Phosphate-sorbitol-broth |
| PCA | Plate Count Agar |
| RVS | Rappaport-Vassiliadis-soya peptone-broth |
| SPB | Salt-polymyxin-broth |
| TCBS | Thiosulfate citrate salt sucrose Agar |
| TSA | Tryptone-Soya-Agar |
| XLD | Xylose lysine deoxycholate agar |
| VRBG | Violet Red Bile Glucose agar |

Organisations

| | |
|---------|--|
| ISO | International Organization for Standardization |
| NMKL | Nordic Committee for Food Analyses |
| SLV/NFA | Livsmedelsverket/National Food Agency, Sweden |

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General information on results evaluation

Statistical evaluation of the results

Highly deviating values that did not belong to a strictly normal distribution were identified as statistical outliers (Grubbs' test modified by Kelly (1)). In some cases, subjective adjustments were made to set limits, based on knowledge of the mixture's contents. Outliers and false results were not included in the calculations of means and standard deviations. Results reported as ">value" were excluded from the evaluation. Results reported as "<value" were interpreted as being zero (negative result). All reported results are presented in Annex 1.



According to EN ISO/IEC 17043, for which the proficiency testing programme organised by the National Food Agency is accredited since early 2012, it is mandatory for the participating laboratories to give method information for all analyses for which they report results. Method information is sometimes difficult to interpret, e.g. several laboratories choose a medium that differs from that in the reported standard methods. Therefore, in the following section, results have been grouped according to the method or the medium used to perform the analysis.

Uncertainty of measurement for the assigned values

The uncertainty of measurement for an assigned value is calculated as the standard deviation divided by the square root of the number of correct results ("standard error"). The assigned value of evaluated parameters is the mean value of participants results.




Tables and figures legend

Tables

| | |
|---|--|
| n | number of laboratory that performed the analysis |
| m | results mean value in log ₁₀ cfu/ml (false results and outliers excluded) |
| s | results standard deviation |
| F | number of false positive or false negative results |
| < | number of low outliers |
| > | number of high outliers |
|  | global results for the analysis |
|  | values discussed in the text |

Figures

Histograms of all analytical results obtained for each mixture are presented. The mean value of the analysis results is indicated in each histogram.

| | |
|---|--|
|  | values within the interval of acceptance (Annex 1) |
|  | outliers |
|  | false negative results |
| * | values outside of the x-axis scale |

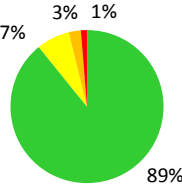
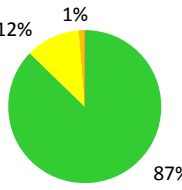
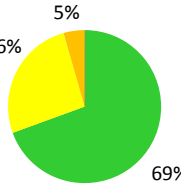
Results of the PT round January 15

General outcome

Samples were sent to 163 laboratories, 34 in Sweden, 111 in other European countries, and 18 outside Europe. 158 laboratories reported results, 47 (30 %) provided at least one result that received an annotation. In the previous round (January 2014) with similar analyses, the proportion was 32 %.

Individual results for each analysis of the PT round are listed in annex 1 and are also available on the website after logging in: www2.slv.se/absint.

Table 1 Microorganisms in each mixture and % of deviating results (F%: false positive or false negative, Out: outliers).

| | | Mixture A | | | Mixture B | | | Mixture C | | |
|---|--------|---|-----------|------------|---|-----------|------------|---|-----------|------------|
| % participants with | |  | | |  | | |  | | |
| 0 annotation 1 annotation 2 annotations >2 annotations | | | | | | | | | | |
| Organisms | | <i>Staphylococcus saprophyticus</i> <i>Hafnia alvei</i> <i>Listeria seeligeri</i> <i>Listeria ivanovii</i> <i>Salmonella Enteritidis</i> <i>Vibrio cholera</i> | | | <i>Citrobacter freundii</i> <i>Listeria monocytogenes</i> <i>Vibrio parahaemolyticus</i> <i>Vibrio cholera</i> | | | <i>Micrococcus sp.</i> <i>Yersinia enterocolitica</i> <i>Campylobacter jejuni</i> <i>Salmonella Dublin</i> <i>Escherichia coli O157</i> | | |
| Analysis | | Target | F% | Out | Target | F% | Out | Target | F% | Out |
| Aerob. microorg, 30 °C | | <i>S. saprophyticus</i> <i>H. alvei</i> | 0 | 3 | <i>C. freundii</i> | 0 | 4 | <i>Micrococcus sp.</i> | 0 | 11 |
| Enterobacteriaceae | | <i>H. alvei</i> | 1 | 5 | <i>C. freundii</i> | 2 | 3 | <i>Y. enterocolitica</i> | 21 | 0 |
| Thermo. camp. | Quant. | - | 0 | - | - | 0 | - | <i>C. jejuni</i> | 18 | 0 |
| | Qual. | - | 0 | - | - | 0 | - | | 0 | - |
| <i>L. mono-</i> <i>cytogenes</i> | Quant. | (<i>L. seeligeri</i>) | 6 | - | <i>L. monocytogenes</i> | 6 | 2 | - | 0 | - |
| | Qual. | (<i>L. ivanovii</i>) | 7 | - | | 0 | - | | 0 | - |
| <i>Salmonella</i> | | <i>S. Enteritidis</i> | 2 | - | (<i>C. freundii</i>) | 2 | - | <i>S. Dublin</i> | 7 | - |
| <i>E. coli</i> O157 | | - | 0 | - | - | 0 | - | <i>E. coli</i> O157 | 4 | - |
| Path. <i>Vibrio</i> spp. | | <i>V. cholera</i> | 4 | - | <i>V. para-</i> <i>haemolyticus</i> <i>V. cholera</i> | 17 | - | - | 9 | - |
| <i>Y. enterocolitica</i> | | - | 7 | - | (<i>C. freundii</i>) | 7 | - | <i>Y. enterocolitica</i> | 0 | - |

- : no target organism or no value; (*microorganism*): false positive

Aerobic microorganisms, 30 °C

Mixture A

The colonies counted for this analysis were mainly from the strains of *Staphylococcus saprophyticus* and *Hafnia alvei* present at the highest concentration in mixture A.

Mixture B

The colonies counted for this analysis were mainly from the strain of *Citrobacter freundii* present at the highest concentration in mixture B.

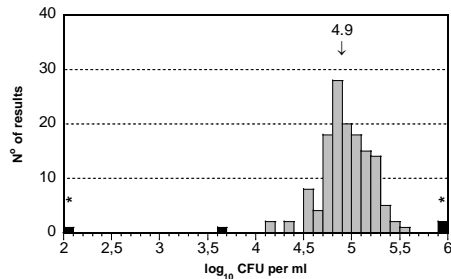
Mixture C

The colonies counted for this analysis were mainly from the strain of *Micrococcus sp.* present at the highest concentration in mixture C.

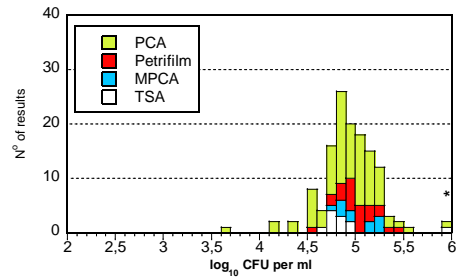
Results of aerobic microorganisms analysis

| Medium | Mixture A | | | | | | Mixture B | | | | | | Mixture C | | | | | |
|---------------|-----------|------|------|---|---|---|-----------|------|------|---|---|---|-----------|------|------|---|----|---|
| | n | m | s | F | < | > | n | m | s | F | < | > | n | m | s | F | < | > |
| Total | 141 | 4.93 | 0.24 | 0 | 2 | 2 | 140 | 3.76 | 0.19 | 0 | 2 | 3 | 141 | 4.47 | 0.12 | 0 | 11 | 5 |
| PCA | 86 | 4.91 | 0.26 | 0 | 1 | 1 | 85 | 3.69 | 0.17 | 0 | 0 | 2 | 86 | 4.48 | 0.11 | 0 | 3 | 2 |
| Petrifilm™ AC | 24 | 5.01 | 0.20 | 0 | 0 | 0 | 24 | 3.92 | 0.14 | 1 | 0 | 0 | 24 | 4.39 | 0.13 | 0 | 4 | 0 |
| MPCA | 11 | 5.01 | 0.18 | 0 | 0 | 0 | 11 | 3.79 | 0.13 | 0 | 0 | 0 | 11 | 4.54 | 0.12 | 0 | 0 | 0 |
| TSA | 11 | 4.78 | 0.08 | 0 | 0 | 1 | 11 | 3.85 | 0.14 | 0 | 0 | 1 | 11 | 4.49 | 0.07 | 0 | 1 | 2 |

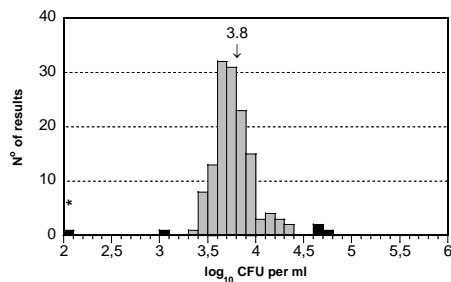
A



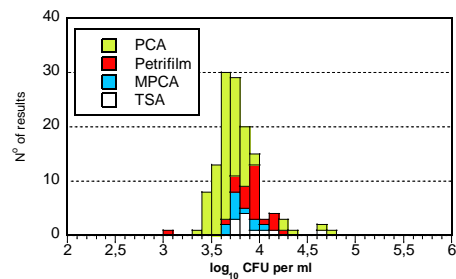
A



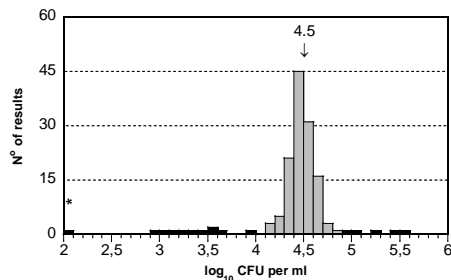
B



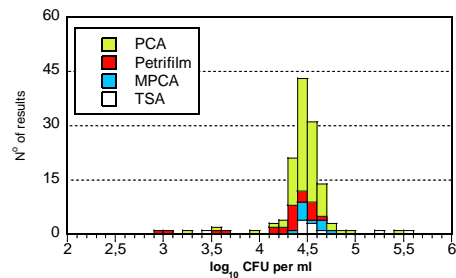
B



C



C



The results from mixture A are more spread (wider peak) than for mixture B and C. In mixture A counted colonies are from two different microorganisms while only from one in mixture B and C; a bigger variability in colonies appearance could lead to a higher variation in colonies enumeration. However this is not true for the results obtained with TSA: for mixture A results obtained by laboratories using this medium are less spread than the overall results (standard deviation 0.08 versus 0.24) and the average value is lower than the global average value (4.78 versus 4.93). This suggest that *S. saprophyticus* and *H. alvei* formed less colonies on TSA and that the reading of plates led somehow to more reproducible counts.

For mixture B, results obtained with the use of Petrifilm™ tend to be higher than the general results average. This suggests that the indicator dye present in Petrifilm™ could facilitate the enumeration of colonies of *C. freundii* and therefore lead to higher counts. Several laboratories reported low outliers for mixture C but these results could not be linked to a specific method and/or medium.

Enterobacteriaceae

Mixture A

Hafnia alvei was the target-organism for this analysis.

Mixture B

Citrobacter freundii was the target-organism for this analysis.

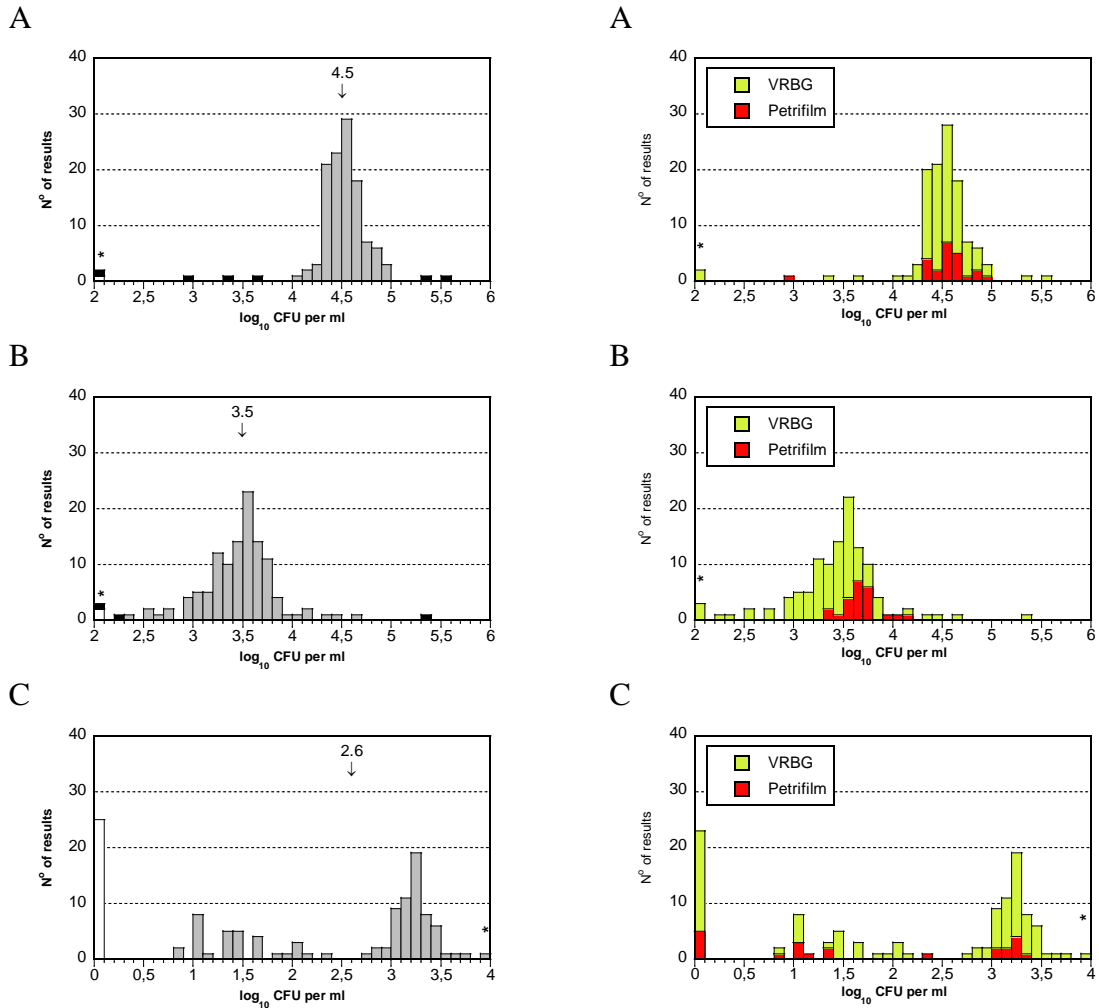
Mixture C

21% of the laboratories reported a false negative result even though mixture C contained three Enterobacteriaceae strains, *Yersinia enterocolitica*, *Salmonella* Dublin and *E. coli* O157 at a concentration of 3.5, 1.1 and 1.2 log₁₀ cfu/ml, respectively. At NFA, *Y. enterocolitica* formed typical but very small colonies on VRBG. Colonies of *Salmonella* and *E. coli* O157 could be counted only if performing the analysis from the undiluted sample or the highest recommended dilution (10⁻¹); these colonies account for the reported results around 1.0 log₁₀ cfu/ml. The small size of *Y. enterocolitica* colonies and the low concentration of *S. Dublin* and *E. coli* O157 explain the high amount of false results as well as the very high dispersion of the results.

Considering the difficulty of the analysis, the results are not evaluated and therefore no z-scores are calculated. Moreover, these results are not taken into account in the tables under the box plots.

Results of Enterobacteriaceae analysis

| Medium | Mixture A | | | | | | Mixture B | | | | | | Mixture C | | | | | |
|-----------------|-----------|------|------|---|---|---|-----------|------|------|---|---|---|-----------|------|------|----|---|---|
| | n | m | s | F | < | > | n | m | s | F | < | > | n | m | s | F | < | > |
| Total | 120 | 4.52 | 0.17 | 1 | 4 | 2 | 120 | 3.46 | 0.36 | 2 | 2 | 1 | 119 | 2.62 | 0.93 | 25 | 0 | 0 |
| VRBG | 94 | 4.51 | 0.16 | 1 | 3 | 2 | 94 | 3.41 | 0.36 | 2 | 2 | 1 | 94 | 2.75 | 0.86 | 20 | 0 | 0 |
| Petrifilm™ Ent. | 23 | 4.58 | 0.16 | 0 | 1 | 0 | 23 | 3.67 | 0.19 | 0 | 0 | 0 | 22 | 2.27 | 1.02 | 5 | 0 | 0 |



Most of the laboratories used VRBG plate or Petrifilm™ for the analysis of Enterobacteriaceae which did not lead to significant results differences when analysing mixture A.

For mixture B, laboratories using Petrifilm™ reported values higher and less spread than those using VRBG. As for the analysis of aerobic microorganisms, it is possible that the indicator dye present in Petrifilm™ facilitated the reading of *C. freundii* colonies and therefore led to a higher and more reproducible count for mixture B.

For mixture C the report of false negative results and low values cannot be linked to a method and/or medium used.

Thermotolerant campylobacter

Mixture A

Mixture A did not contain any strain of thermotolerant campylobacter.

Mixture B

There was no target-organism for this analysis in mixture B.

Mixture C

Mixture C contained a strain of *Campylobacter jejuni* at a concentration of 1.5 log₁₀ cfu/ml.

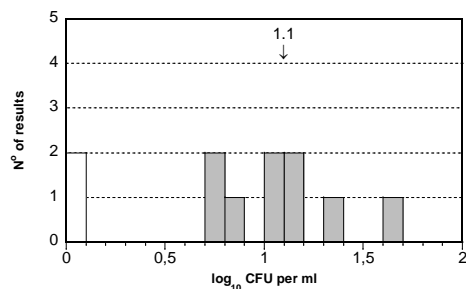
Results of thermotolerant campylobacter quantitative analysis

| Method | Mixture A | | | | | Mixture B | | | | | Mixture C | | | | |
|------------------|-----------|---|---|---|-----|-----------|---|---|---|-----|-----------|------|------|---|-----|
| | n | m | s | F | < > | n | m | s | F | < > | n | m | s | F | < > |
| Total | 11 | - | - | 0 | - - | 11 | - | - | 0 | - - | 11 | 1.06 | 0.28 | 2 | 0 0 |
| ISO 10272-2:2006 | 6 | - | - | 0 | - - | 6 | - | - | 0 | - - | 6 | 1.12 | 0.31 | 1 | 0 0 |
| NMKL 119:2007 | 5 | - | - | 0 | - - | 5 | - | - | 0 | - - | 5 | 0.98 | 0.17 | 1 | 0 0 |

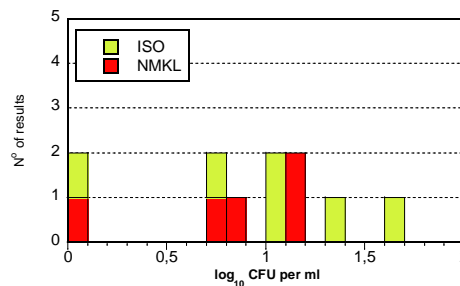
Results of thermotolerant campylobacter qualitative analysis

| Method | Mixture A | | | | | Mixture B | | | | | Mixture C | | | | |
|------------------|-----------|-----|---|---|-----|-----------|-----|---|---|-----|-----------|-----|---|---|-----|
| | n | m | s | F | < > | n | m | s | F | < > | n | m | s | F | < > |
| Total | 31 | neg | - | 0 | - - | 31 | neg | - | 0 | - - | 31 | pos | - | 0 | - - |
| ISO 10272-1:2006 | 9 | neg | - | 0 | - - | 9 | neg | - | 0 | - - | 9 | pos | - | 0 | - - |
| NMKL 119:2007 | 16 | neg | - | 0 | - - | 16 | neg | - | 0 | - - | 16 | pos | - | 0 | - - |

C



C



Few laboratories participate in the quantitative analysis of thermotolerant campylobacter, it is therefore quite difficult to draw any conclusion regarding the use of different methods.

Listeria monocytogenes

Mixture A

A strain of *Listeria seeligeri* and *Listeria ivanovii* were included in mixture A. On ALOA medium, colonies of *L. ivanovii* can be misjudged as *L. monocytogenes*. On blood-based medium (LMBA), and medium revealing esculine hydrolysis (PALCAM and Oxford) both *L. seeligeri* and *L. ivanovii* form colonies similar to *L. monocytogenes*. However, in the confirmation steps, these strains can be differentiated: both *L. seeligeri* and *L. ivanovii* ferment xylose while *L. monocytogenes* does not.

Mixture B

Mixture B contained a strain of *L. monocytogenes* at a concentration of 1.1 log₁₀ cfu/ml.

Mixture C

No target-organism was present in mixture C for this analysis.

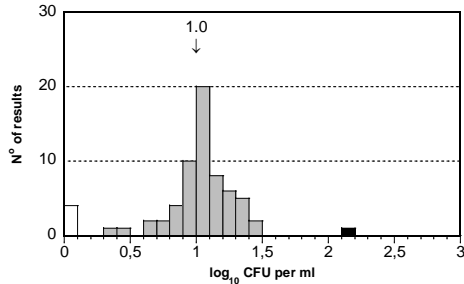
Results of L. monocytogenes quantitative analysis

| Method | Mixture A | | | | | Mixture B | | | | | Mixture C | | | | |
|------------------|-----------|---|---|---|-----|-----------|------|------|---|-----|-----------|---|---|---|-----|
| | n | m | s | F | < > | n | m | s | F | < > | n | m | s | F | < > |
| Total | 66 | - | - | 4 | - - | 66 | 1.02 | 0.21 | 4 | 0 1 | 66 | - | - | 0 | - - |
| ISO 11290-2:1998 | 30 | - | - | 1 | - - | 30 | 1.05 | 0.25 | 1 | 0 1 | 30 | - | - | 0 | - - |
| NMKL 136:2010 | 14 | - | - | 1 | - - | 14 | 1.07 | 0.10 | 2 | 0 0 | 14 | - | - | 0 | - - |
| Rapid L.m | 15 | - | - | 2 | - - | 15 | 0.93 | 0.19 | 1 | 0 0 | 15 | - | - | 0 | - - |

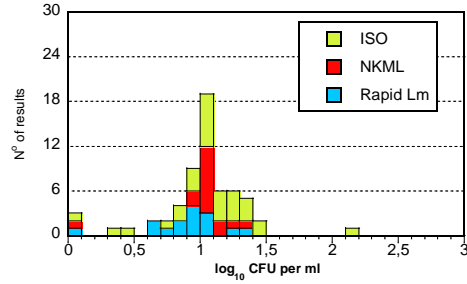
Results of L. monocytogenes qualitative analysis

| Method | Mixture A | | | | | Mixture B | | | | | Mixture C | | | | |
|------------------|-----------|-----|---|---|-----|-----------|-----|---|---|-----|-----------|-----|---|---|-----|
| | n | m | s | F | < > | n | m | s | F | < > | n | m | s | F | < > |
| Total | 89 | neg | - | 6 | - - | 89 | pos | - | 0 | - - | 89 | neg | - | 0 | - - |
| ISO 11290-1:1996 | 27 | neg | - | 2 | - - | 27 | pos | - | 0 | - - | 27 | neg | - | 0 | - - |
| NMKL 136:2010 | 14 | neg | - | 1 | - - | 14 | pos | - | 0 | - - | 14 | neg | - | 0 | - - |
| VIDAS | 19 | neg | - | 0 | - - | 19 | pos | - | 0 | - - | 19 | neg | - | 0 | - - |
| Rapid L.m | 14 | neg | - | 2 | - - | 14 | pos | - | 0 | - - | 14 | neg | - | 0 | - - |
| PCR | 9 | neg | - | 0 | - - | 9 | pos | - | 0 | - - | 14 | neg | - | 0 | - - |

B



B



No correlation between method used and false results or outliers can be concluded.

Salmonella

Mixture A

Mixture A contained a strain of *Salmonella* Enteritidis at a concentration of 1.2 log₁₀ cfu/ml.

Mixture B

Even though mixture B did not contain any *Salmonella*, some false positive results were reported. *Citrobacter freundii* present in mixture B form atypical yellow colonies on XLD and brownish colonies on BriS agar that differentiate from black and violet colonies of *Salmonella* on the same media.

Mixture C

A strain of *Salmonella* Dublin was target-organism for this analysis. Under our quality control, after enrichment in BPW and RVS, this strain formed typical colonies on XLD medium but atypical white colonies on BriS chromogenic medium. Moreover, this strain is sensitive to temperature above 42°C and to high concentration of MgCl₂ in RVS medium (2). According to NMKL method this concentration should not be higher than 29 g/l. These characteristics might explain the report of 9 false negative results. The concentration of *S. Dublin* in mixture C was 1.1 log₁₀ cfu/ml.

Results of *Salmonella* qualitative analysis

| Method | Mixture A | | | | | Mixture B | | | | | Mixture C | | | | |
|---------------|-----------|-----|---|---|-----|-----------|-----|---|---|-----|-----------|-----|---|---|-----|
| | n | m | s | F | < > | n | m | s | F | < > | n | m | s | F | < > |
| Total | 124 | pos | - | 2 | - - | 124 | neg | - | 2 | - - | 124 | pos | - | 9 | - - |
| ISO 6579:2002 | 23 | pos | - | 1 | - - | 23 | neg | - | 0 | - - | 23 | pos | - | 1 | - - |
| NMKL 71:1999 | 39 | pos | - | 0 | - - | 39 | neg | - | 0 | - - | 39 | pos | - | 4 | - - |
| NMKL 187:2007 | 7 | pos | - | 0 | - - | 7 | neg | - | 0 | - - | 7 | pos | - | 0 | - - |
| VIDAS | 18 | pos | - | 0 | - - | 18 | neg | - | 0 | - - | 18 | pos | - | 1 | - - |
| PCR | 16 | pos | - | 0 | - - | 16 | neg | - | 0 | - - | 16 | pos | - | 0 | - - |

No correlation between the method used and false negative result can be concluded.

Escherichia coli O157

Mixture A

Mixture A did not contain any *E. coli* O157 strain.

Mixture B

Mixture B did not contain any *E. coli* O157 strain.

Mixture C

Mixture C contained an *E. coli* O157 strain at a concentration of 1.2 log₁₀ cfu/ml.

Results of *E. coli* O157 qualitative analysis

| Method | Mixture A | | | | | Mixture B | | | | | Mixture C | | | | |
|----------------|-----------|-----|---|---|-----|-----------|-----|---|---|-----|-----------|-----|---|---|-----|
| | n | m | s | F | < > | n | m | s | F | < > | n | m | s | F | < > |
| Total | 24 | neg | - | 0 | - - | 24 | neg | - | 0 | - - | 24 | pos | - | 1 | - - |
| ISO 16654:2001 | 6 | neg | - | 0 | - - | 6 | neg | - | 0 | - - | 6 | pos | - | 0 | - - |
| NMKL 164:2005 | 5 | neg | - | 0 | - - | 5 | neg | - | 0 | - - | 5 | pos | - | 0 | - - |

Almost all laboratories (79%) used mTSB or BPW for the enrichment step and CT-SMAC, alone or together with another medium, for the isolation step. In addition to the ISO and NMKL method, laboratories used PCR, immunological or “in house” methods.

It is important to note that methods for the analysis of *E. coli* are not suitable for the analysis of *E. coli* O157.

Pathogenic *Vibrio* spp.

Mixture A

A strain of *Vibrio cholera* at a concentration of 5.0 log₁₀ cfu/ml was target-organism for this analysis. At NFA, the strain formed typical yellow colonies on TCBS plate after enrichment in APW 2 % or SPB.

Mixture B

Mixture B contained a strain of *Vibrio cholera* and a strain of *Vibrio parahaemolyticus* at a concentration of 2.8 och 2.9 log₁₀ cfu/ml, respectively. At NFA both strains formed typical colonies on TCBS after enrichment in APW 2% or SPB. Despite the presence of two target-organisms, 4 laboratories reported a false negative result.

Mixture C

No target-organism was present in mixture C for this analysis.

Results of pathogenic Vibrio spp. qualitative analysis

| Method | Mixture A | | | | | Mixture B | | | | | Mixture C | | | | |
|---------------------|-----------|-----|---|---|-----|-----------|-----|---|---|-----|-----------|-----|---|---|-----|
| | n | m | s | F | < > | n | m | s | F | < > | n | m | s | F | < > |
| Total | 23 | pos | - | 1 | - - | 23 | pos | - | 4 | - - | 22 | neg | - | 2 | - - |
| ISO/TS 21872-1:2007 | 11 | pos | - | 1 | - - | 11 | pos | - | 1 | - - | 11 | neg | - | 1 | - - |
| NMKL 156:1997 | 10 | pos | - | 0 | - - | 10 | pos | - | 3 | - - | 9 | neg | - | 1 | - - |

The standard method ISO/TS 21872-1:2007 prescribes an enrichment in APW 2%, while the method NMKL 156:1997 recommends an enrichment in APW 2% for the isolation of *V. cholera* and an enrichment in SPB for the isolation of *V. parahaemolyticus*.

No correlation between false results and method or medium used could be seen.

Yersinia enterocolitica

Mixture A

No target-organism was present in mixture A for this analysis.

Mixture B

There was no target-organism for this analysis in mixture B. Under our quality control, *C. freundii* formed pink colonies on CIN after incubation in PSB during 3 hours at room temperature and 3 weeks at 4°C. No growth was observed on CIN after incubation in MRB. Biochemical confirmation tests (API20E) differentiated colonies of *C. freundii* from *Y. enterocolitica*.

Mixture C

Mixture C contained a *Yersinia enterocolitica* strain which was also target-organism for the analysis of Enterobacteriaceae.

Results of Y. enterocolitica qualitative analysis

| Method | Mixture A | | | | | Mixture B | | | | | Mixture C | | | | |
|----------------|-----------|-----|---|---|-----|-----------|-----|---|---|-----|-----------|-----|---|---|-----|
| | n | m | s | F | < > | n | m | s | F | < > | n | m | s | F | < > |
| Total | 14 | neg | - | 1 | - - | 14 | neg | - | 1 | - - | 14 | pos | - | 0 | - - |
| ISO 10273:2003 | 7 | neg | - | 1 | - - | 7 | neg | - | 0 | - - | 7 | pos | - | 0 | - - |
| NMKL 117:1996 | 4 | neg | - | 0 | - - | 4 | neg | - | 0 | - - | 4 | pos | - | 0 | - - |

Outcome of the results of individual laboratory - assessment

In order to allow comparison of the results from different analyses and mixtures, all the results of the analyses were transformed into standard values (z-scores). For quantitative analyses, a z-score is either positive or negative, depending on whether the individual result is higher or lower than the mean value calculated from all laboratory results for each analysis. For qualitative analyses, a z-score of zero is attributed for a correct answer. The z-scores obtained, which are listed in Annex 2, can be used as a tool by laboratories when following up on the results.

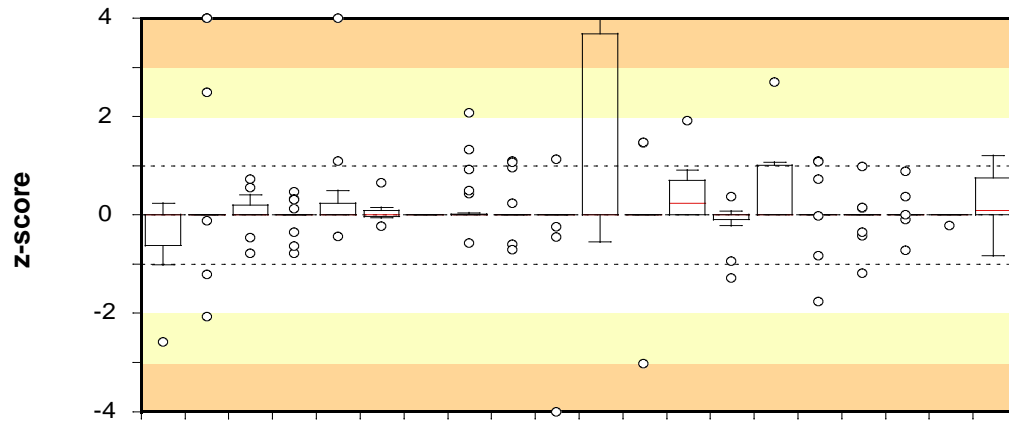
All the results from each laboratory – outliers included and false results excluded – were compiled into a box plot based on their z-scores. The smaller and more centred round zero the box of a laboratory is, the closer its results are to the general mean values calculated for all laboratory results.

The laboratories were not grouped or ranked based on their results. However, for each laboratory, the numbers of false results and outliers are presented below the box plots. These results are also highlighted in Annex 1, where all the reported results are listed, and the minimum and maximum accepted values for each analysis are stated.

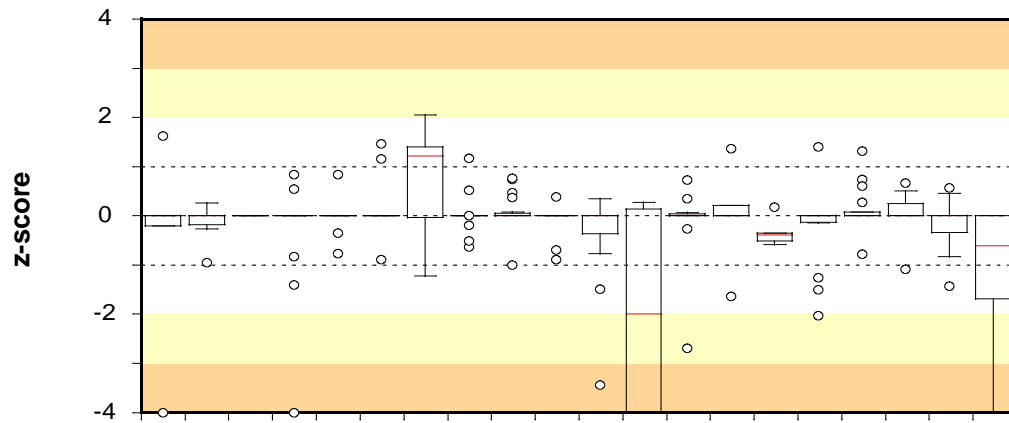
Information on the results processing and recommendations for follow-up work are given in the Scheme Protocol (3). Samples for follow-up can be ordered, free of charge via our website: www.livsmedelsverket.se/en/PT-extra

Box plots and numbers of deviating results for each laboratory

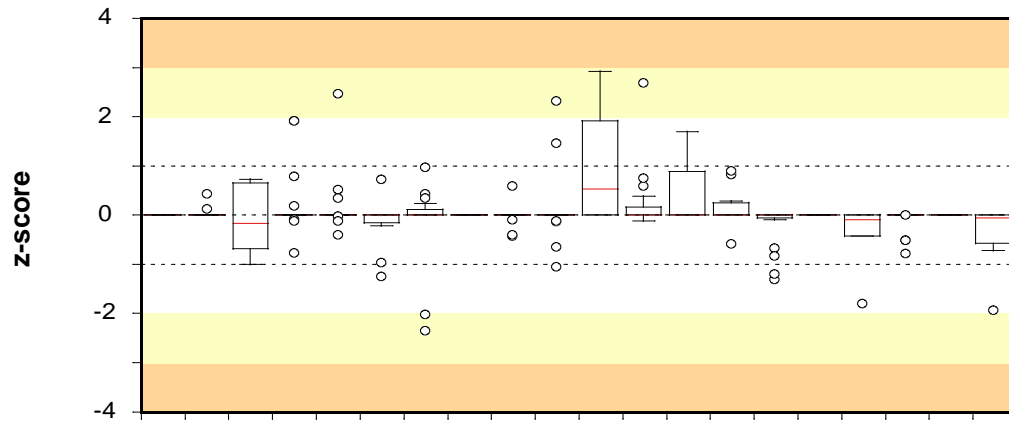
- *The plots are based on the laboratory results from all analyses transformed into z-scores calculated according to the formula: $z = (x-m)/s$, where x is the result of the individual laboratory, m is the mean of the results of all participating laboratories, and s is the standard deviation.*
- *Correct results for quantitative analyses without target organism and for qualitative analyses generate a z-value of 0.*
- *The laboratory median value is illustrated by a horizontal red line in the box.*
- *The box includes 50 % of a laboratory's results (25 % of the results above the median and 25 % of the results below the median). The remaining 50 % are illustrated by lines and circles outside the box.*
- *Very deviating results are represented by circles and are calculated as follow: the lowest result in the box $- 1.5 \times$ (the highest result in the box $-$ the lowest result in the box) or the highest result in the box $+ 1.5 \times$ (the highest result in the box $-$ the lowest result in the box). z-scores higher than +4 and less than -4 are positioned at +4 and -4 , respectively, in the plot.*
- *The background is divided by lines and shaded fields to indicate ranges in order to simplify location of laboratory results.*



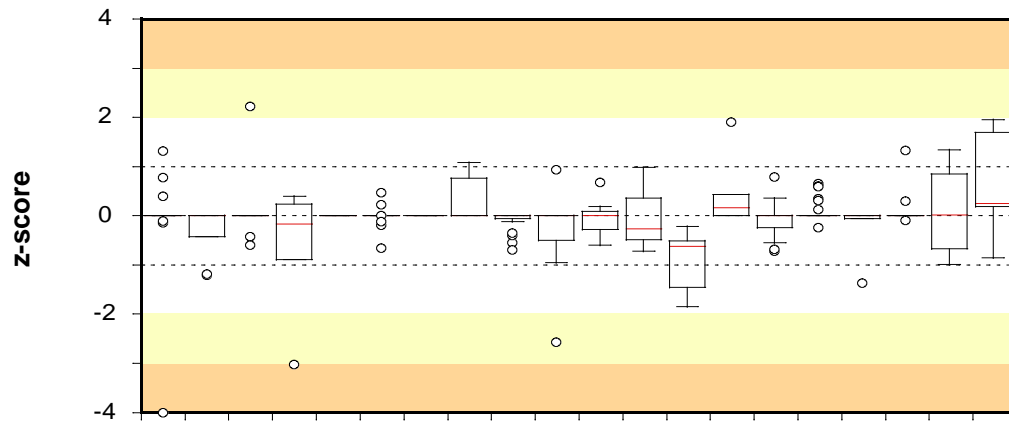
| Lab no | 1254 | 1290 | 1594 | 1970 | 2035 | 2050 | 2058 | 2072 | 2129 | 2151 | 2324 | 2386 | 2402 | 2637 | 2670 | 2704 | 2745 | 2764 | 2842 | 2920 | |
|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|---|
| No. of results | 14 | 16 | 11 | 20 | 14 | 8 | - | 23 | 17 | 15 | 11 | 9 | 8 | 14 | 9 | 14 | 14 | 14 | 13 | 8 | |
| False positive | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - |
| False negative | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Low outliers | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - |
| High outliers | - | 2 | - | - | 1 | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - | - | - |



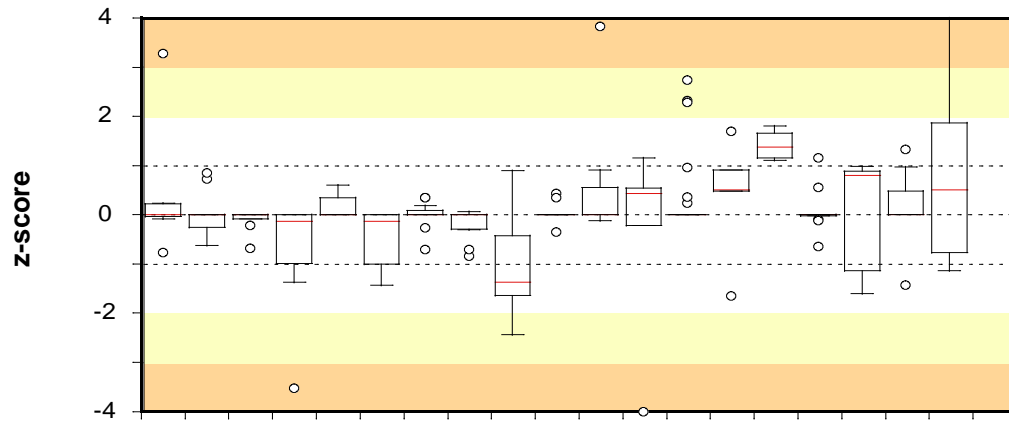
| Lab no | 3126 | 3159 | 3225 | 3305 | 3457 | 3533 | 3587 | 3595 | 3626 | 3825 | 3868 | 3878 | 3923 | 3925 | 4064 | 4100 | 4153 | 4171 | 4246 | 4288 | |
|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|---|
| No. of results | 6 | 14 | - | 16 | 11 | 9 | 5 | 14 | 20 | 9 | 20 | 4 | 11 | 6 | 5 | 15 | 17 | 11 | 11 | 8 | |
| False positive | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| False negative | - | - | - | - | 1 | - | - | - | - | - | - | 2 | - | - | - | 2 | - | - | - | - | - |
| Low outliers | 1 | - | - | 1 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | 1 |
| High outliers | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |



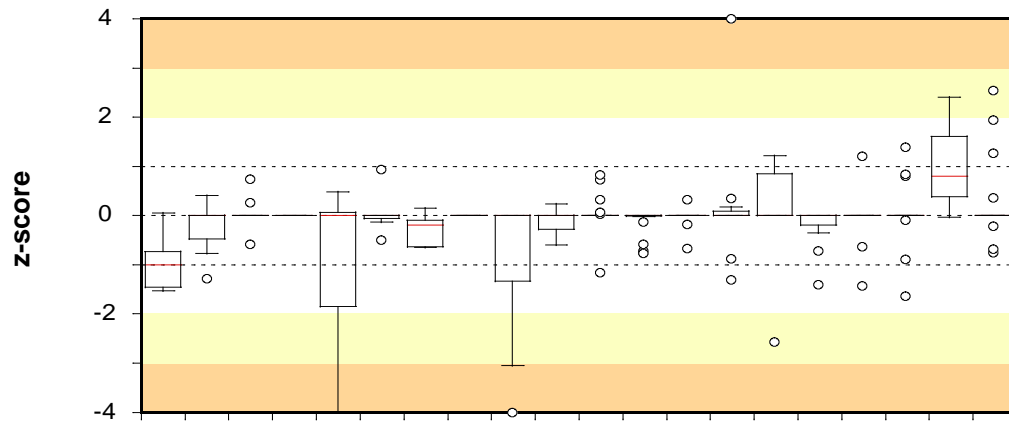
| Lab no | 4339 | 4352 | 4400 | 4562 | 4633 | 4635 | 4664 | 4683 | 4817 | 4840 | 4879 | 4889 | 4955 | 4980 | 5018 | 5028 | 5100 | 5120 | 5188 | 5197 |
|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| No. of results | - | 19 | 5 | 29 | 14 | 11 | 16 | - | 24 | 17 | 10 | 17 | 14 | 14 | 19 | 3 | 6 | 16 | 3 | 8 |
| False positive | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| False negative | - | 1 | - | - | - | - | 1 | - | - | - | 1 | - | - | - | - | - | - | 1 | - | - |
| Low outliers | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| High outliers | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |



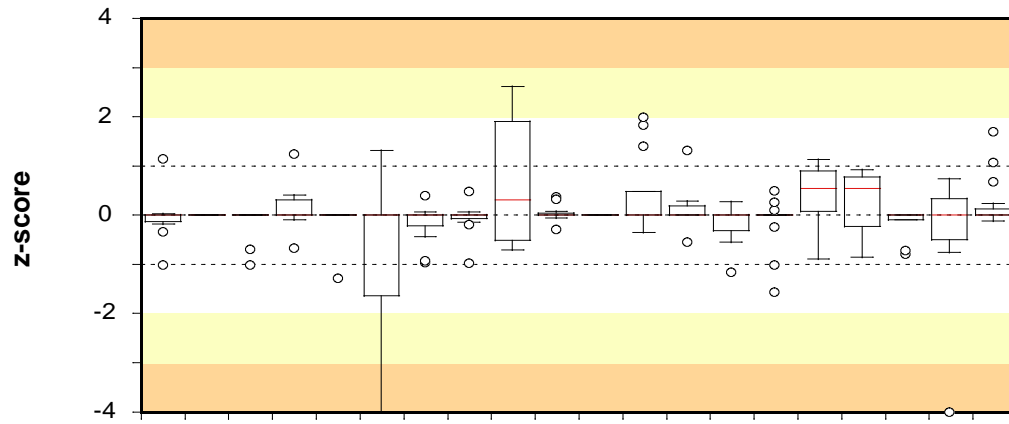
| Lab no | 5204 | 5220 | 5304 | 5329 | 5333 | 5352 | 5447 | 5545 | 5553 | 5615 | 5632 | 5701 | 5801 | 5808 | 5883 | 5950 | 5993 | 6109 | 6175 | 6224 |
|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| No. of results | 17 | 9 | 9 | 5 | 6 | 14 | 3 | 6 | 19 | 11 | 8 | 3 | 5 | 6 | 14 | 28 | 5 | 9 | 4 | 5 |
| False positive | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | 1 | - | - | - | - |
| False negative | - | - | - | - | - | - | - | 1 | 1 | - | - | - | - | - | - | - | - | - | 1 | - |
| Low outliers | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| High outliers | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |



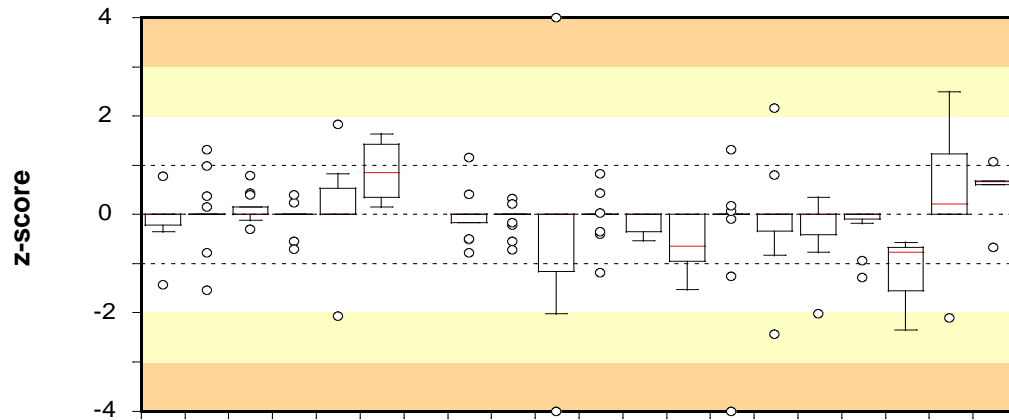
| Lab no | 6232 | 6253 | 6343 | 6352 | 6368 | 6443 | 6456 | 6594 | 6658 | 6686 | 6707 | 6762 | 6860 | 6971 | 7024 | 7096 | 7182 | 7191 | 7207 | 7232 |
|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| No. of results | 8 | 11 | 9 | 8 | 17 | 7 | 11 | 11 | 5 | 9 | 14 | 5 | 28 | 5 | 5 | 14 | 5 | 7 | 5 | 3 |
| False positive | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - |
| False negative | - | - | - | - | - | 1 | - | - | - | - | - | - | 1 | - | - | - | - | 2 | - | - |
| Low outliers | - | - | - | 1 | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - |
| High outliers | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | 1 | 3 |



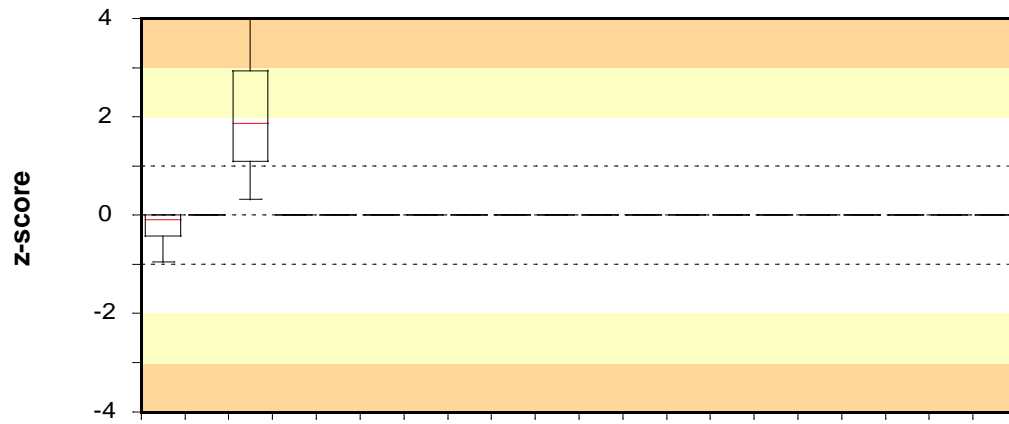
| Lab no | 7242 | 7248 | 7253 | 7302 | 7330 | 7334 | 7449 | 7564 | 7596 | 7627 | 7688 | 7706 | 7728 | 7750 | 7825 | 7876 | 7882 | 7930 | 7940 | 7946 |
|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| No. of results | 5 | 17 | 14 | 9 | 8 | 8 | 5 | - | 16 | 8 | 23 | 23 | 12 | 11 | 11 | 14 | 9 | 14 | 3 | 27 |
| False positive | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| False negative | - | - | - | - | - | 1 | - | - | - | 1 | - | - | - | - | - | - | - | - | - | 2 |
| Low outliers | - | - | - | - | 1 | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - |
| High outliers | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |



| Lab no | 7962 | 8042 | 8066 | 8068 | 8165 | 8260 | 8313 | 8333 | 8397 | 8435 | 8528 | 8529 | 8568 | 8626 | 8628 | 8657 | 8734 | 8742 | 8756 | 8766 |
|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| No. of results | 14 | 3 | 9 | 14 | 15 | 12 | 11 | 11 | 5 | 11 | 2 | 14 | 14 | 12 | 14 | 5 | 5 | 9 | 7 | 17 |
| False positive | - | - | - | - | - | 2 | - | - | - | - | - | - | - | 1 | - | - | - | - | 1 | - |
| False negative | - | - | 2 | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - | - | - | - |
| Low outliers | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - |
| High outliers | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |



| Lab no | 8918 | 8955 | 9002 | 9034 | 9051 | 9078 | 9217 | 9429 | 9436 | 9441 | 9451 | 9453 | 9555 | 9569 | 9589 | 9662 | 9716 | 9747 | 9753 | 9890 |
|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| No. of results | 9 | 26 | 14 | 14 | 8 | 5 | 5 | 14 | 17 | 12 | 13 | 11 | 8 | 17 | 14 | 14 | 12 | 3 | 8 | 5 |
| False positive | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - |
| False negative | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| Low outliers | - | - | - | - | - | - | 5 | - | - | 1 | - | - | - | 1 | - | - | - | - | - | - |
| High outliers | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |



| Lab no | 9903 | 9923 | 9950 |
|----------------|------|------|------|
| No. of results | 10 | - | 3 |
| False positive | 1 | - | - |
| False negative | - | - | - |
| Low outliers | - | - | - |
| High outliers | - | - | 1 |

Test material and quality control

Test material

Each laboratory received three freeze-dried microbial mixtures designated A-C. The manufactured test material was freeze-dried in portions of 0.5 ml in vials, as described by Peterz and Steneryd (4). Before analysing the samples, the contents of each vial had to be dissolved in 254 ml of diluent. The organisms present in the mixtures are listed in Table 2.

Table 2. *Microorganisms present in mixture A-C supplied to participants*

| Mixture ¹ | Microorganism | Strain no. |
|----------------------|-------------------------------------|------------|
| A | <i>Staphylococcus saprophyticus</i> | SLV-013 |
| | <i>Hafnia alvei</i> | SLV-015 |
| | <i>Listeria seeligeri</i> | SLV-347 |
| | <i>Listeria ivanovii</i> | SLV-348 |
| | <i>Salmonella</i> Enteritidis | SLV-436 |
| | <i>Vibrio cholera</i> | SLV-530 |
| B | <i>Citrobacter freundii</i> | SLV-091 |
| | <i>Listeria monocytogenes</i> | SLV-444 |
| | <i>Vibrio parahaemolyticus</i> | SLV-529 |
| | <i>Vibrio cholera</i> | SLV-530 |
| C | <i>Micrococcus</i> sp. | SLV-055 |
| | <i>Yersinia enterocolitica</i> | SLV-408 |
| | <i>Campylobacter jejuni</i> | SLV-540 |
| | <i>Salmonella</i> Dublin | SLV-242 |
| | <i>Escherichia coli</i> O157 | SLV-479 |

¹The links between the mixtures and the randomised sample numbers are shown in annex 1

Quality control of the mixtures

It is essential to have aliquots of homogeneous mixture and equal volume in all vials in order to allow comparison of all freeze-dried samples from one mixture. Quality control was performed in conjunction with manufacturing of the mixtures according to Scheme Protocol (3). The results are presented in Table 3. Homogeneity requires that the standard deviation and the difference between the highest and lowest value of results from 10 samples analysed do not exceed 0.15 log₁₀ units and 0.5 log₁₀ units, respectively.

Table 3. Concentration mean (*m*) and standard deviation (*s*) from analyses of 10 randomly selected vials per mixture, expressed in log₁₀ cfu (colony forming units) per ml of sample.

| Analysis and method | A | | B | | C | |
|---|-------|-------|-------|-------|--------|--------|
| | m | s | m | s | m | s |
| Aerobic microorganisms 30 °C NMKL-method no. 86 | 5.17 | 0.04 | 3.83 | 0.06 | 4.48 | 0.05 |
| Enterobacteriaceae NMKL-method no. 144 | 4.36 | 0.05 | 3.69 | 0.06 | 3.50 | 0.06 |
| Thermotolerant campylobacter, quant. NMKL method no. 119 | – | – | – | – | 1.52 | 0.15 |
| Thermotolerant campylobacter, qual. NMKL method no. 119 | – | – | neg | – | pos | – |
| <i>Listeria monocytogenes</i> , quant. NMKL method no. 136 | – | – | 1.13 | 0.06 | – | – |
| <i>Listeria monocytogenes</i> , qual. NMKL method no. 136 | – | – | pos | – | neg | – |
| <i>Salmonella</i> NMKL method no. 71 | 1.22* | 0.15* | neg | – | 1.12* | 0.04* |
| <i>Escherichia coli</i> O157 NMKL method no. 164 | neg | – | neg | – | 1.22** | 0.03** |
| Pathogenic <i>Vibrio</i> spp. NMKL-method no. 156 | 5.01* | 0.08* | 2.95* | 0.07* | – | – |
| <i>Yersinia enterocolitica</i> NMKL-method no. 117 | neg | – | neg | – | 3.50 | 0.06 |

– No target organism

* Internal values based on the analyses results of parallel mixtures

** Values based on the analyses results of thermotolerant coliform bacteria and *E. coli* (NMKL method no 125)

References

1. Kelly, K. 1990. Outlier detection in collaborative studies. *J. Assoc. Off. Anal. Chem.* 73:58-64.
2. Peterz, Mats et al. 1989. The effect of incubation temperature and magnesium chloride concentration on growth of salmonella in home-made and in commercially available dehydrated Rappaport-Vassiliadis broths. *J. of Applied Bacteriology.* 523-528.
3. Anonymous, 2012. Protocol. Microbiology. Drinking Water & Food. The National Food Agency.
4. Peterz. M. Steneryd. A.C. 1993. Freeze-dried mixed cultures as reference samples in quantitative and qualitative microbiological examinations of food. *J. Appl. Bacteriol.* 74:143-148.

| Lab no. | sample | Aerobic microorganisms 30 °C | | | Enterobacteriaceae | | | Thermotolerant campylobacter | | | Listeria monocytogenes | | | Thermotolerant campylobacter | | | Listeria monocytogenes | | | Salmonella | | | Escherichia coli O157 (VT-neg) | | | Pathogenic Vibrio spp | | | Yersinia enterocolitica | | | Lab no. |
|---------|--------|------------------------------|--------|--------|--------------------|--------|---|------------------------------|-------|---|------------------------|-------|---|------------------------------|---|---|------------------------|---|---|------------|---|---|--------------------------------|---|---|-----------------------|---|---|-------------------------|---|---|---------|
| | | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | |
| 4840 | 2 3 1 | 1.459 | -1.047 | 2.322 | -0.650 | -0.131 | | | | 0 | -0.115 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | 4840 | | | |
| 4879 | 2 1 3 | 1.091 | 2.920 | 1.071 | 2.588 | 1.917 | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | 4879 | | | |
| 4889 | 1 3 2 | 0.595 | 0.379 | 0.162 | 0.747 | 2.689 | | | | 0 | -0.115 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4889 | | | |
| 4955 | 3 1 2 | 1.418 | 0.883 | 1.238 | 1.688 | 0.851 | | | | 0 | 0 | 0.075 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4955 | | | |
| 4980 | 2 3 1 | 0.025 | 0.829 | 0.904 | 0.249 | 0.290 | | | | 0 | -0.589 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4980 | | | |
| 5018 | 3 2 1 | -0.098 | -0.672 | -0.014 | -1.310 | -1.197 | | | | 0 | -0.826 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5018 | | | |
| 5028 | 3 2 1 | | | | | | | | | | | | | | | | | | | | | | | 0 | | 0 | | | 5028 | | | |
| 5100 | 1 3 2 | -0.426 | -1.798 | -0.180 | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 5100 | | | |
| 5120 | 3 2 1 | -0.508 | -0.779 | -0.514 | 0.009 | 0.009 | | | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5120 | | | |
| 5188 | 2 3 1 | | | | | | | | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5188 | | | |
| 5197 | 1 3 2 | -0.426 | -0.726 | -1.932 | -0.111 | 0.009 | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 5197 | | | |
| 5204 | 2 1 3 | -0.139 | 0.775 | -4.000 | -0.111 | 0.402 | | | | 0 | 1.309 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5204 | | | |
| 5220 | 1 2 3 | -0.426 | -1.208 | -1.181 | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 5220 | | | |
| 5304 | 1 3 2 | -0.426 | 2.223 | -0.597 | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 5304 | | | |
| 5329 | 3 1 2 | 0.394 | -0.887 | 0.237 | -0.171 | -3.021 | | | | | | | | | | | | | | | | | | | | | | | 5329 | | | |
| 5333 | 3 2 1 | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 5333 | | | |
| 5352 | 3 2 1 | 0.000 | -0.656 | -0.197 | 0.225 | 0.467 | | | | 0 | -0.115 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5352 | | | |
| 5447 | 2 3 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | 5447 | | | |
| 5545 | 1 3 2 | | | | 1.089 | 0.767 | | | | | | | | | | | | | | | | | | | | | | | 5545 | | | |
| 5553 | 1 3 2 | -0.549 | -0.404 | -0.347 | | -0.692 | | | | 0 | -0.115 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5553 | | | |
| 5615 | 1 2 3 | -0.057 | 0.936 | -0.931 | -0.950 | -2.572 | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 5615 | | | |
| 5632 | 1 3 2 | 0.681 | -0.404 | -0.597 | 0.189 | -0.159 | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 5632 | | | |
| 5701 | 3 1 2 | -0.713 | 0.990 | -0.264 | | | | | | | | | | | | | | | | | | | | | | | | | 5701 | | | |
| 5801 | 2 3 1 | -1.450 | -0.619 | -0.514 | -1.849 | -0.215 | | | | | | | | | | | | | | | | | | | | | | | 5801 | | | |
| 5808 | 1 2 3 | 0.435 | 1.901 | 0.320 | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 5808 | | | |
| 5883 | 3 1 2 | -0.713 | -0.243 | -0.681 | 0.789 | -0.552 | | | | 0 | 0.360 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5883 | | | |
| 5950 | 3 1 2 | 0.353 | -0.243 | 0.654 | 0.609 | 0.122 | 0 | 0 | 0.316 | 0 | 0.597 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5950 | | | |
| 5993 | 3 2 1 | | | | -0.051 | -1.365 | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 5993 | | | |
| 6109 | 2 1 3 | -0.098 | 0.293 | 1.321 | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 6109 | | | |
| 6175 | 1 2 3 | 1.336 | -0.994 | -0.347 | 0.369 | | | | | | | | | | | | | | | | | | | | | | | | 6175 | | | |
| 6224 | 2 1 3 | 0.189 | 1.955 | -0.848 | 0.249 | 1.693 | | | | | | | | | | | | | | | | | | | | | | | 6224 | | | |
| 6232 | 1 2 3 | 0.214 | 0.234 | -0.764 | -0.081 | 3.272 | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 6232 | | | |
| 6253 | 2 3 1 | -0.508 | -0.619 | -0.514 | 0.729 | 0.851 | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 6253 | | | |
| 6343 | 3 1 2 | -0.221 | -0.082 | -0.681 | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 6343 | | | |
| 6352 | 2 3 1 | -0.139 | -1.369 | -0.597 | -0.111 | -3.526 | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 6352 | | | |
| 6368 | 1 2 3 | 0.476 | 0.454 | 0.570 | 0.609 | 0.346 | | | | 0 | 0.075 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6368 | | | |
| 6443 | 2 3 1 | -1.409 | -0.136 | -0.597 | -1.430 | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 6443 | | | |
| 6456 | 2 3 1 | 0.189 | 0.347 | -0.264 | -0.710 | 0.346 | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 6456 | | | |
| 6594 | 3 1 2 | -0.836 | -0.297 | 0.070 | -0.710 | -0.271 | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 6594 | | | |
| 6658 | 3 1 2 | -0.426 | -1.637 | 0.904 | -1.370 | -2.431 | | | | | | | | | | | | | | | | | | | | | | | 6658 | | | |
| 6686 | 2 3 1 | | | | 0.429 | 0.346 | | | | | | | | | | | | | | | | | | | | | | | 6686 | | | |
| 6707 | 1 3 2 | 0.886 | 0.561 | 3.824 | 0.489 | 0.907 | | | | 0 | -0.115 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6707 | | | |
| 6762 | 1 2 3 | -0.221 | 1.151 | -4.000 | 0.429 | 0.543 | | | | | | | | | | | | | | | | | | | | | | | 6762 | | | |
| 6860 | 2 3 1 | 2.320 | 0.239 | 2.739 | 2.288 | 0.963 | | | 0 | 0 | 0.360 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6860 | | | |
| 6971 | 3 2 1 | -1.655 | 0.507 | 0.487 | 1.688 | 0.907 | | | | | | | | | | | | | | | | | | | | | | | 6971 | | | |
| 7024 | 3 2 1 | 1.377 | 1.151 | 1.655 | 1.808 | 1.104 | | | | | | | | | | | | | | | | | | | | | | | 7024 | | | |
| 7096 | 2 1 3 | 0.558 | 1.151 | -0.097 | -0.650 | -0.019 | | | | 0 | -0.115 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7096 | | | |
| 7182 | 3 2 1 | 0.886 | 0.990 | -1.598 | -1.130 | 0.795 | | | | | | | | | | | | | | | | | | | | | | | 7182 | | | |
| 7191 | 1 2 3 | 0.968 | -1.423 | 1.321 | | | | | | | | | | | | | | | | | | | 0 | 0 | | | | | 7191 | | | |
| 7207 | 3 2 1 | 1.869 | 0.507 | 4.000 | -0.770 | -1.141 | | | | | | | | | | | | | | | | | | | | | | | 7207 | | | |
| 7232 | 1 2 3 | 4.000 | 4.000 | 4.000 | | | | | | | | | | | | | | | | | | | | | | | | | 7232 | | | |
| 7242 | 2 1 3 | -1.454 | -1.530 | -1.006 | -0.728 | 0.057 | | | | | | | | | | | | | | | | | | | | | | | 7242 | | | |
| 7248 | 2 1 3 | -1.286 | -0.511 | -0.597 | -0.770 | -0.468 | | | | 0 | 0.407 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7248 | | | |
| 7253 | 1 3 2 | | | | -0.590 | 0.739 | | | | 0 | 0.265 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7253 | | | |
| 7302 | 3 2 1 | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 7302 | | | |
| 7330 | 3 2 1 | -3.213 | 0.132 | 0.487 | -4.000 | -0.468 | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 7330 | | | |
| 7334 | 3 1 2 | -0.127 | -0.495 | 0.937 | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 7334 | | | |

Internal and external control for microbiological analyses of food and drinking water

All analytical activities require work of a high standard that is accurately documented. For this purpose, most laboratories carry out some form of internal quality assurance, but their analytical work also has to be evaluated by an independent party. Such external quality control of laboratory competence is commonly required by accreditation bodies and can be done by taking part in proficiency testing (PT).

In a proficiency test, identical test material is analysed by a number of laboratories using their routine methods. The organiser evaluates the results and compiles them in a report.

The National Food Agency's PT program offers

- External and independent evaluation of laboratories analytical competence.
- Improved knowledge of analytical methods with respect to various types of organisms.
- Expert support.
- Tool for inspections regarding accreditation.
- Free extra material for follow-up analyses.

For more information visit our website: www2.slv.se/absint



The National Food Agency's reference material

As a complement to the proficiency testing, National Food Agency produces also reference material (RM) for internal quality control: a total of 8 RM for food and drinking water microbiological analyses, including pathogens, are available.

Information available on our website: www.livsmedelsverket.se/en/RM-micro