Proficiency Testing

Drinking Water Microbiology

September 2018

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Proficiency testing

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Parameters included

Coliform bacteria and ***Escherichia coli*** with membrane filter method (MF)

Coliform bacteria and ***Escherichia coli***, (rapid methods with MPN)

Suspected thermotolerant coliform bacteria with MF (not assessed)

Intestinal enterococci with MF

Pseudomonas aeruginosa with MF

Culturable microorganisms (total count) 3 days incubation at **22±2 °C**

Culturable microorganisms (total count) 2 days incubation at **36±2 °C**

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Abbreviations and explanations

Microbiological media

CCA Chromocult Coliform Agar® (Merck; EN ISO 9308-1:2014)
Colilert Colilert® Quanti-Tray® (IDEXX Inc.; EN ISO 9308-2:2014)
Enterolert Enterolert® Quanti-Tray® (IDEXX Inc.)
LES m-Endo Agar LES (according to SS 028167)
LTTC m-Lactose TTC Agar with Tergitol (according to EN ISO 9308-1:2000)
m-Ent m-Enterococcus Agar (Slanetz & Bartley; accord. to EN ISO 7899-2:2000)
m-FC m-FC Agar (according to SS 028167)
PACN Pseudomonas Agar base/CN agar (with cetrimide and nalidixic acid; according to EN ISO 16266:2008)
Pseudalert Pseudalert® Quanti-Tray® (IDEXX Inc.; ISO 16266-2:2018)
YEA Yeast extract Agar (according to EN ISO 6222:1999)

Other abbreviations

MF Membrane filter (method)
MPN "Most Probable Number" (quantification based on statistical distributions)
ISO "International Organization for Standardization" and their standards
EN European standard from "Comité Européen de Normalisation" (CEN)
NMKL "Nordisk Metodikkomité for næringsmidler" and their standards
DS, NS, SFS, SS National standards from Denmark, Norway, Finland and Sweden

Legend to method comparison tables

N total number of laboratories that reported methods and numerical results
n number of results except false results and outliers
Mv mean value (with outliers and false results *excluded*)
Med median value (with outliers and false results *included*)
CV coefficient of variation = relative standard deviation in percentage of the mean, calculated from square root transformed results
F number of false positive or false negative results
< number of low outliers
> number of high outliers
total number of results for the parameter
601 remarkably low result
278 remarkably high result or CV or many deviating results

Explanations to histograms with accepted and deviating results

result without remark
false negative result
outlier
↓ 34 average without deviating results
* result beyond the nearest x-axis limit

Contents

General information on results evaluation

The proficiency testing program organised by the National Food Agency is accredited against EN ISO/IEC 17043. This standard prescribes that results should be grouped based on the method used. Therefore it is mandatory for participants to inform about method data. Method data where differences are present or could be expected are here reported for each parameter.

The method information gathered is sometimes difficult to interpret. Sometimes there is inconsistency between the standard referred to and the information given regarding various method details. Results from laboratories with ambiguous details are either excluded or placed in the group "Other/Unknown" in the tables, together with results from methods used only by individual laboratories. To obtain an as appropriate evaluation as possible of the results, it is important that used standards and method details are reported.

Outliers and false results are not included in the calculation of mean value and measure of dispersion for the various method groups. The numbers of low and high outliers, as well as false results, are instead explicitly given in tables together with the group means etc. The mean and measure of dispersion are not shown for groups with 4 or fewer results, more than exceptionally when it is specifically mentioned. However, all results are shown in the method histograms when possible.

The histograms and calculation of outliers are described on page 28 under "Processing of numerical results" with further reference to the scheme protocol [1].

Results of the PT round

General outcome

Test items were sent to 94 laboratories, 35 in Sweden, 48 in other Nordic countries (Faeroe Islands, Greenland and Åland included), 2 more from EU, 3 from the rest of Europe and 6 from countries outside Europe. Results were reported from 91 laboratories.

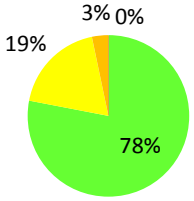
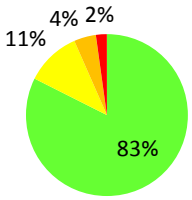
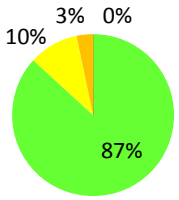
The percentages of false results and outliers are compiled in **table 1**. These deviating results are excluded in most calculations.

Microorganisms and parameters of analyses are also compiled in **table 1**. For the MF analyses the parameters *suspected* coliform bacteria and *suspected* thermotolerant coliform bacteria (shaded in table 1 and table 3), as well as *suspected* intestinal enterococci and *suspected* Pseudomonas aeruginosa on primary media could be reported as well. The results from the parameters "suspected" are only used for interpretations and discussions and are not assessed.

All reported results are compiled in **annex A** and results for each laboratory are also shown on our website after logging in (https://www2.slv.se/absint).

Standardized z-scores for all evaluated results are given in **annex B** and photographs with examples of colony appearance on various media are presented in **annex C**.

Table 1 *Microorganisms in each mixture and percentages of deviating results (F%: false positive or false negative, X%: outliers); parameters with grey rows are not assessed*

Mixture	**A**			**B**			**C**		
Percentage of laboratories with 0 deviating results 1 deviating result 2 deviating results >2 deviating results									
No. of evaluable results	511			516			503		
No. of deviating results *	23 (5 %)			26 (5 %)			21 (4 %)		
Microorganisms	*Escherichia coli* *Klebsiella pneumoniae* *Lactobacillus plantarum* *Pseudomonas aeruginosa* *Staphylococcus saprophyticus*			*Klebsiella pneumoniae* *Enterobacter aerogenes* *Enterococcus hirae* *Burkholderia cepacia* *Staphylococcus capitis*			*Escherichia coli (gas neg.)* *Klebsiella oxytoca* *Enterococcus durans* *Pseudomonas aeruginosa*		
Analysis	**Target org.**	**F%**	**X%**	**Target org.**	**F%**	**X%**	**Target org.**	**F%**	**X%**
Coliform bacteria (MF)	*E. coli* *K. pneumoniae*	2	6	*K. pneumoniae* *E. aerogenes*	2	6	*E. coli* *K. oxytoca*	3	3
Susp. thermotolerant coliform bact. (MF)	*E. coli* *K. pneumoniae*	–	–	*K. pneumoniae* *{E. aerogenes}*	–	–	*E. coli*	–	–
E. coli (MF)	*E. coli* *{[K. pneumon.]}*	2	0	*{[K. pneumon.]}*	3	–	*E. coli*	10#	0
Coliform bacteria (rapid method)	*E. coli* *K. pneumoniae*	0	0	*K. pneumoniae* *E. aerogenes*	0	2	*E. coli* *K. oxytoca*	0	2
E. coli (rapid meth.)	*E. coli*	2	0	–	2	–	*E. coli*	4	0
Intestinal enterococci (MF)	*[L. plantarum]* *[S. saprophyt.]*	14	–	*E. hirae*	0	3	*E. durans*	0	7
Pseudomonas aeruginosa (MF)	*P. aeruginosa*	0	4	*[B. cepacia]*	0	–	*P. aeruginosa*	4	0
Culturable micro-organisms (total count), 3 days 22 °C	*L. plantarum* *S. saprophyt.* *(K. pneumon.)* *(E. coli)* *(P. aeruginosa)*	0	5	*E. hirae* *K. pneumoniae* *E. aerogenes* *(B. cepacia)*	1	8	*K. oxytoca* *E. coli* *E. durans* *(P. aeruginosa)*	0	0
Culturable micro-organisms (total count), 2 days 36 °C	*L. plantarum* *S. saprophyt.* *(K. pneumon.)* *(E. coli)* *(P. aeruginosa)*	1	1	*S. capitis* *E. hirae* *K. pneumoniae* *E. aerogenes* *(B. cepacia)*	1	8	*K. oxytoca* *E. coli* *E. durans* *(P. aeruginosa)*	1	1

* In total 35 of 91 laboratories (38 %) reported at least one deviating result; see also the last note below

– Organism missing or numerical result irrelevant

( ) The organism contributes with only very few colonies

[ ] The organism is false positive on the primary growth medium

{ } The organism may give different results depending on method or definition used

\# There are 6 zero results (10 %) that are reckoned as false negative or accepted results dependent on the method used

Coliform bacteria (MF)

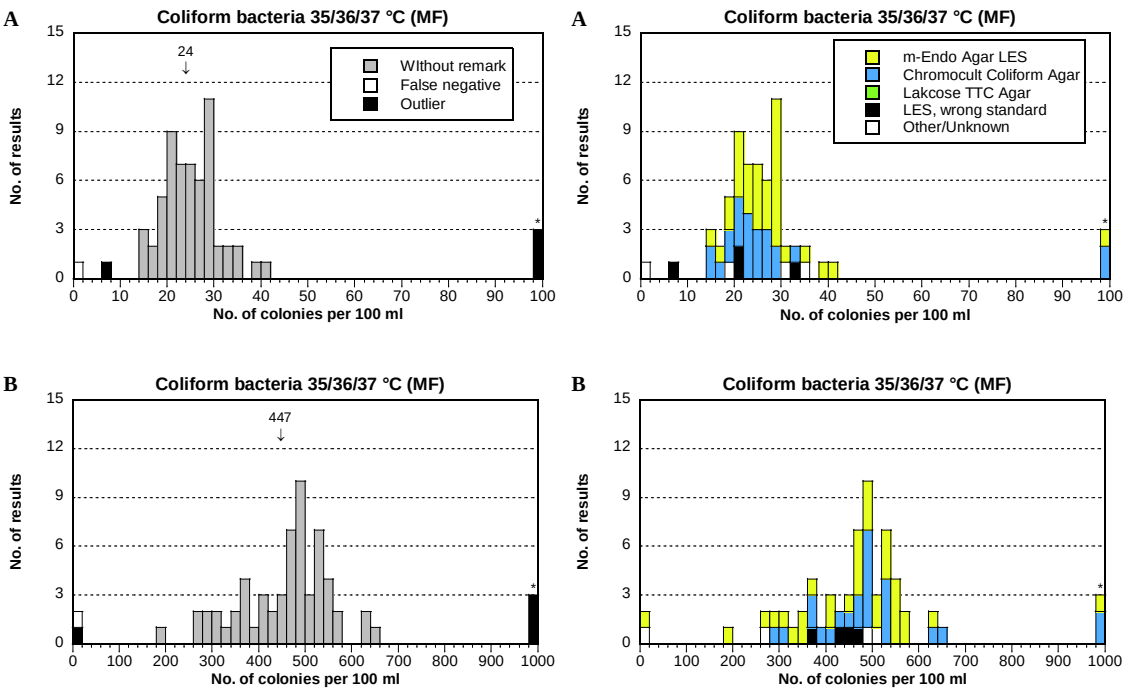
In some cases m-Endo Agar LES (LES) has been used although not prescribed in the standard referred to (ISO 9308-1:2000 or ISO 9308-1:2014). These results have been placed in a separate group, "LES, wrong standard".

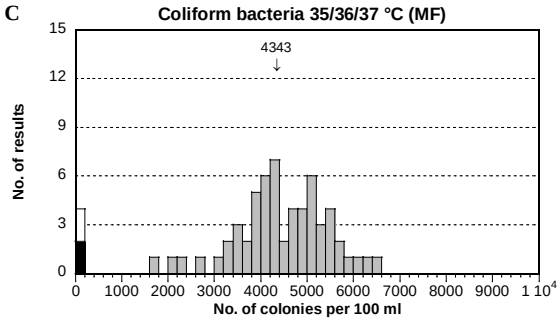
From the table it is clear that LES was used by more laboratories than other media. The proportion that used CCA has increased even more compared to previous years, while the use of LTTC has ceased completely. This is logical since CCA has replaced LTTC in the latest edition of EN ISO 9308-1 from 2014.

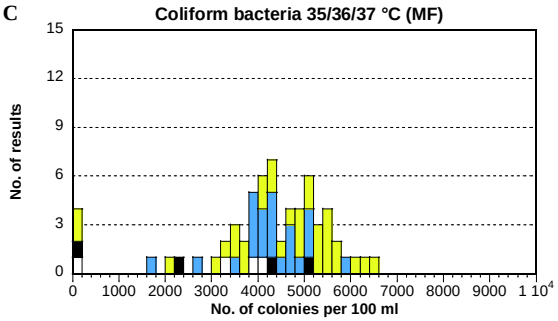
This time there is no clear tendency when comparing LES and CCA. Perhaps there is a somewhat lower average result for CCA in sample C. Lower results for CCA have been seen in several previous rounds.

The relative dispersion (CV) is almost identical between LES and CCA in the various samples.

Medium	N	A						B						C					
		n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>
Total	64	58	**24**	12	1	1	3	59	**447**	11	1	1	3	59	**4343**	12	2	2	0
m-Endo Agar LES	32	31	**25**	11	0	0	1	30	**445**	12	1	0	1	30	**4614**	12	1	1	0
Chromocult Colif. A.	24	21	**23**	10	0	0	2	22	**460**	10	0	0	2	23	**4148**	11	0	0	0
Lactose TTC Agar	0	0	–	–	–	–	–	0	–	–	–	–	–	0	–	–	–	–	–
LES, wrong standard	4	3	–	–	0	1	0	4	–	–	0	0	0	3	–	–	1	0	0
Other/Unknown	4	3	–	–	1	0	0	3	–	–	0	1	0	3	–	–	0	1	0







Sample A

- Two strains of coliform bacteria were included, *Escherichia coli* and *Klebsiella pneumoniae*. Both grow with typical colonies on MF media, with a metallic sheen on LES and bluish and pink, respectively, on CCA at 36±2 °C (see annex C). They are negative when confirmed with the oxidase test.
- The result distribution was good. Five deviating results were present.

Sample B

- Two typical strains of coliform bacteria were included, *Enterobacter aerogenes* and *K. pneumoniae* (other strain than in mixture A). Both grow with typical colonies on MF media at 36±2 °C, with a metallic sheen on LES and pink on CCA. They are oxidase negative when confirmed. The colonies of *E. aerogenes* may sometimes appear more or less reddish on LES.
- The result distribution was good. Five deviating results were present.

Sample C

- Two typical strains of coliform bacteria were present, *E. coli* and *Klebsiella oxytoca*. Both grow with typical colonies on MF media, with a metallic sheen on LES, and bluish and pink, respectively, on CCA at 36±2 °C. They are oxidase negative when confirmed.
- The distribution was fairly good but there appears to be two peaks. There is no good explanation to this tendency, so probably it is just one wide peak that seems to have two peaks by the chosen axis scale and pure accident.
- Four low deviating results were present. Further, there is a tendency to an over-representation of other low results as well.

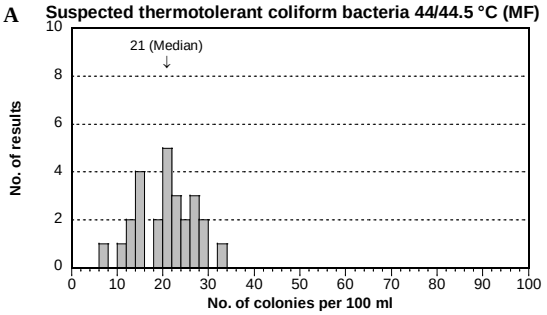
Suspected thermotolerant coliform bacteria (MF)

The parameter is not included in performance assessment since only suspected (not confirmed) colonies are asked for. Therefore, no identification is done of outliers excluded in calculations. The *medians* are therefore given in the table and histograms as they are more robust than the means.

The only growth medium that for sure has been used this time is m-FC agar. The incubation temperature is 44 or 44.5 °C. For sample B it appears that the results at 44.5 °C are lower than at 44 °C. This is further strengthened by the fact that the mean

No grouping	N	A						B						C					
		n	**Med**	CV	F	<	>	n	**Med**	CV	F	<	>	n	**Med**	CV	F	<	>
Total	26	26	**21**	–	–	–	–	26	**305**	–	–	–	–	26	**2650**	–	–	–	–
44 °C	16	16	**21**	–	–	–	–	16	**324**	–	–	–	–	16	**2650**	–	–	–	–
44,5 °C	5	5	**21**	–	–	–	–	5	**194**	–	–	–	–	5	**2600**	–	–	–	–
Other/Unknown	5	5	**18**	–	–	–	–	5	**220**	–	–	–	–	5	**3090**	–	–	–	–

A



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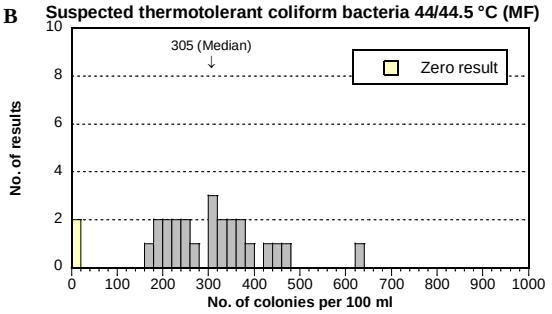

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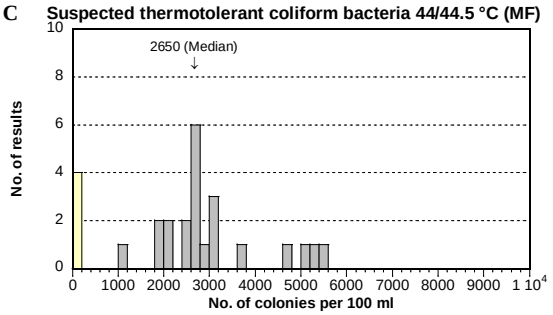


at 44.5 °C was only 86 cfu/100 ml while it was 318 cfu/100 ml at 44 °C. The group Other/Unknown is probably a mixture of the temperatures.

Sample A

- The strains of *E. coli* and *K. pneumoniae* both appear with blue colonies on m-FC at 44/44.5 °C. The results correspond quite well to those for coliform bacteria. Thus, both strains are included.
- The result distribution was narrow and therefore unusually good.

Sample B

- *K. pneumoniae* was the only thermotolerant coliform bacterium in the sample. The strain of *E. aerogenes* can also grow sometimes but with colonies that not are blue but pale greyish.
- The results are generally lower than those for coliform bacteria at 36±2 °C. Probably, and correctly, mainly the colonies of *K. pneumoniae* were counted.
- Two zero results were obtained.

Sample C

- The strain of *E. coli* appears as a suspected thermotolerant bacterium with blue colonies on m-FC at 44/44.5 °C. The strain of *K. oxytoca* usually doesn't grow at 44 °C.
- The result distribution (average 2078 cfu/100 ml) more resembles the one for *E. coli* than the one for coliform bacteria. However, the results are quite dispersed and may indicate that *K. oxytoca* has, unexpectedly, appeared at times. An incubation temperature lower than 44 °C can then be suspected.
- Four zero results were obtained. A reason may be that some laboratories have performed gas tests as confirmation that in some countries is the rule for thermotolerant coliform bacteria (however, it should not be applied to suspected thermotolerant coliform bacteria). Namely, the strain of *E. coli* is gas negative and would then be excluded from the (suspected) thermotolerant coliform bacteria. The results would then be zero.

Escherichia coli (MF)

To identify and quantify *E. coli* from the primary media LES, LTTC and m-FC, confirmation must be done, irrespectively if the plates are incubated at 36±2 °C or at 44/44.5 °C. Depending on the method, test of either indole production or *β*-glucuronidase activity of oxidase negative presumptive colonies is used as necessary confirmation. Violet to blue colonies on CCA means positive *β*-glucuronidase activity and is registered as confirmed *E. coli*.

The primary growth media CCA, LES as well as LTTC are used at 36±2 °C and LTTC or m-FC at 44/44.5 °C. The results are here separated in groups based on the used standard. For the standards from the Nordic countries (SS, SFS, NS) the majority of the results are from 36±2 °C but some also from 44/44.5 °C. The results are additionally grouped based on reported incubation temperature.

Groups based on media with the incubation stated to 36±2 °C are shown in a separate table.

There is no clear difference in results in relation to the incubation temperature. This time there is even no indication of lower results with Norwegian standard (NS 4792) that sometimes has been seen in previous rounds. Instead there might be an indication that Swedish standard has given higher results in sample C. In the table 6 false negative results are stated for sample C. However, none of these are by use of ISO 9308-1:2014 with CCA. Some of these zero results may, however, be acceptable, see below under Sample C.

All results

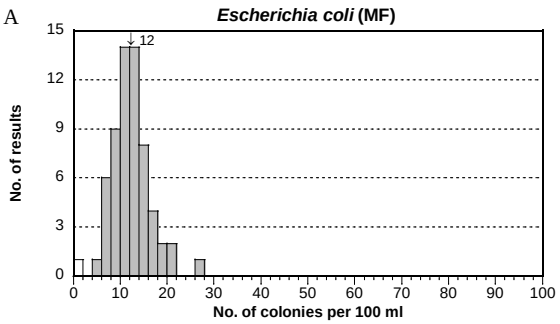
Origin &Standard	N	A						B						C					
		n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>
Total	63	61	**12**	17	1	0	0	61	**0**	–	2	–	–	56	**3028**	14	6	0	0
Colony origin																			
36 ± 2 °C	42	41	**11**	16	0	0	0	41	**0**	–	1	–	–	40	**2969**	14	1	0	0
44/44.5 °C	10	10	**12**	16	0	0	0	10	**0**	–	0	–	–	8	**3288**	14	2	0	0
36 ± 2 & 44/44.5 °C	9	8	**13**	22	1	0	0	8	**0**	–	1	–	–	6	**3413**	10	3	0	0
Other/Unknown	2	2	**–**	–	0	0	0	2	**0**	–	0	–	–	2	**–**	–	0	0	0
Standard																			
ISO 9308-1:2000	3	3	**13**	30	0	0	0	2	**0**	–	1	–	–	2	**3009**	15	1	0	0
ISO 9308-1:2014	24	23	**11**	16	0	0	0	23	**0**	–	1	–	–	23	**3003**	14	0	0	0
SS 028167	11	11	**11**	11	0	0	0	11	**0**	–	0	–	–	11	**3492**	10	0	0	0
SFS 4088	14	14	**12**	17	0	0	0	14	**0**	–	0	–	–	13	**2926**	13	1	0	0
NS 4792	3	3	**–**	–	0	0	0	3	**0**	–	0	–	–	1	**–**	–	2	0	0
Other/Unknown	8	7	**13**	22	1	0	0	8	**0**	–	0	–	–	6	**2272**	13	2	0	0

Results for E. coli from the analysis of coliform bacteria MF at 36±2 °C

Medium	N	A						B						C					
		n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>
Total	***45#***	***44***	***11***	***16***	***0***	*0*	***0***	***44***	***0***	***–***	***1***	***–***	***–***	***43***	***2956***	***14***	***1***	*0*	***0***
m-Endo Agar LES	20	20	**12**	16	6	0	0	20	**0**	–	0	–	–	19	**2984**	14	1	0	0
Lactose TTC Agar	0	0	**–**	–	–	–	–	0	**–**	–	–	–	–	0	**–**	–	–	–	–
CCA	24	23	**10**	16	2	0	0	23	**0**	–	1	–	–	23	**2954**	15	0	0	0
Other/Unknown	1	1	**–**	–	0	0	0	1	**0**	–	0	–	–	1	**–**	–	0	0	0

Compare table above – some more laboratories performed the analysis of *E. coli* at 36±2 °C but not of coliform bacteria

A



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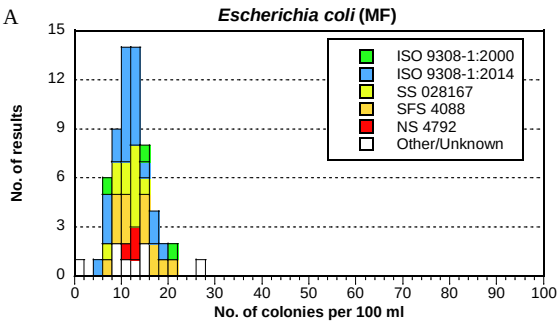

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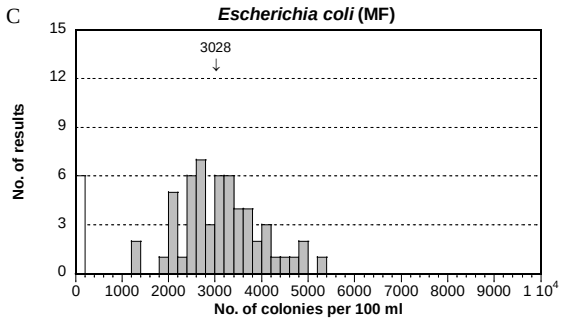
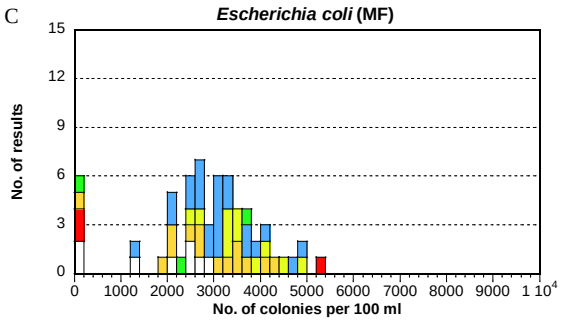




Sample A

- One typical *E. coli* strain was included. It shows *β*-glucuronidase activity, indole production and also gas production when fermenting lactose. It grows with typical colonies on the various primary growth media.
- The average 12 cfu/100 ml was the same as for the rapid method.
- The results were highly accumulated and, thus, showed a very good distribution. One false negative result was present.

Sample B

- No *E. coli* was included but two false positive results were obtained.

Sample C

- One strain of *E. coli* with normal *β*-glucuronidase activity and indole production but no gas production from lactose fermentation was present in the mixture. It appears with typical colonies on the various primary growth media, see annex C.
- Six zero results were recorded among the 62 results. Since the average is high, the zero results cannot be obtained accidentally. There was no zero result with ISO 9308-1:2014 using CCA. They were instead obtained from methods using lactose fermentation. **If gas production is a crucial criterion to be judged as *E. coli*, these zero results have to be reckoned as acceptable although they are here stated as false negative results.** In many countries, e.g. Sweden, there is no requirement for gas test. Zero results under such circumstances, as well as from CCA, must be seen as strict false negative values. All 6 laboratories with zero results have stated the use of a gas test, which supports the assumption above. Incubation at 44.5 °C may alternatively be the cause to some zero results.
- The distribution was good except the 6 zero results, which are handled separately. Beside these there were no more deviating results.

Coliform bacteria & *E. coli* (rapid methods, MPN)

The rapid methods used for both these parameters were exclusively Colilert® Quanti-Tray® from the manufacturer Idexx Inc. with incubation at 35, 36 or 37 °C. Out of the 60 laboratories that reported Colilert some used trays with 51 wells, while others used trays with 97 wells. The laboratories often analysed both diluted and undiluted samples. Yellow wells (ONPG positive; with *β*-galactosidase activity) are interpreted as coliform bacteria and yellow wells also exhibiting fluorescence (MUG positive; with *β*-glucuronidase activity) are interpreted as *E. coli*.

The maximum incubation time is a bit vague for some laboratories. Six laboratories have incubated up to 24 hours. One of these has reported 23-24 hours while all the others reported just 24 hours, out of which 3 stated the use of "Colilert 24 hours". The average results for this group were deviating for coliform bacteria, in two cases higher and in one case lower than for other groups. Despite only 4 results, the average and CV for "Colilert 24 hours" in sample C are shown as comparison. The differences may accidentally be an effect of the few results. No differences were seen between the groups that incubated up to 20 or 22 hours.

Sample A

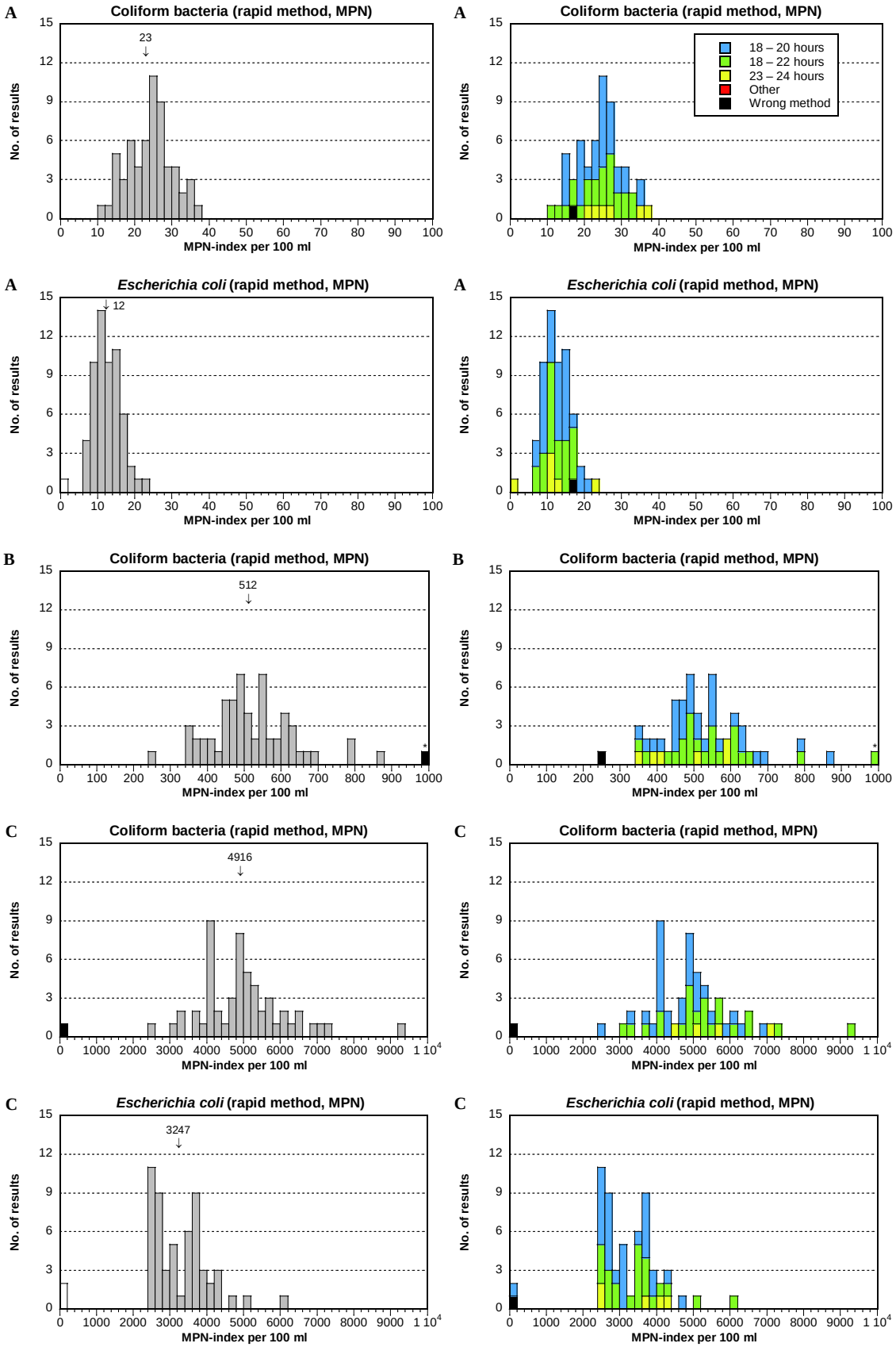
- The strains of *E. coli* and *K. pneumoniae* grow and possess *β*-galactosidase. They are thus detected as coliform bacteria by methods based on the activity of this enzyme (ONPG positive), e.g. Colilert®-18/24 Quanti-Tray® where ONPG is a substrate.

Coliform bacteria, Rapid method with MPN

Incubation time	N	A						B						C					
		n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>
Total, Rapid meth.	60	59	**23**	13	0	0	0	57	**517**	10	0	0	1	54	**4916**	12	0	1	0
18 to 20 hours	30	30	**23**	12	0	0	0	29	**525**	11	0	0	0	28	**4623**	10	0	0	0
18 to 22 hours	23	23	**23**	14	0	0	0	22	**523**	10	0	0	1	22	**5188**	13	0	0	0
24 hours	6	6	**27**	12	0	0	0	6	**464**	12	0	0	0	4	**5535**	10	0	0	0
Other	0	0	–	–	–	–	–	0	–	–	–	–	–	0	–	–	–	–	–
Wrong method	1	1	–	–	0	0	0	1	–	–	0	0	0	0	–	–	0	1	0

E. coli, Rapid method with MPN

Incubation time	N	A						B						C					
		n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>
Total, Rapid meth.	60	58	**12**	15	1	0	0	59	**0**	–	1	–	–	55	**3247**	11	2	0	0
18 to 20 hours	30	30	**12**	16	0	0	0	30	**0**	–	0	–	–	28	**3099**	10	1	0	0
18 to 22 hours	23	23	**12**	14	0	0	0	23	**0**	–	0	–	–	22	**3417**	12	0	0	0
24 hours	6	5	**13**	17	1	0	0	6	**0**	–	0	–	–	5	**3343**	13	0	0	0
Other	0	0	–	–	–	–	–	0	–	–	–	–	–	0	–	–	–	–	–
Wrong method	1	1	–	–	0	0	0	0	–	–	1	–	-	0	–	–	1	0	0


A
Coliform bacteria (rapid method, MPN)
23
No. of results
MPN-index per 100 ml
A
Coliform bacteria (rapid method, MPN)
18 – 20 hours
18 – 22 hours
23 – 24 hours
Other
Wrong method
No. of results
MPN-index per 100 ml
A
Escherichia coli (rapid method, MPN)
12
No. of results
MPN-index per 100 ml
A
Escherichia coli (rapid method, MPN)
No. of results
MPN-index per 100 ml
B
Coliform bacteria (rapid method, MPN)
512
No. of results
MPN-index per 100 ml
B
Coliform bacteria (rapid method, MPN)
No. of results
MPN-index per 100 ml
C
Coliform bacteria (rapid method, MPN)
4916
No. of results
MPN-index per 100 ml
C
Coliform bacteria (rapid method, MPN)
No. of results
MPN-index per 100 ml
C
Escherichia coli (rapid method, MPN)
3247
No. of results
MPN-index per 100 ml
C
Escherichia coli (rapid method, MPN)
No. of results
MPN-index per 100 ml

- Only the strain of *E. coli* possesses the enzyme *β*-glucuronidase and is also detected as *E. coli*. One false negative result for *E. coli* was present.
- The averages for this sample were about the same as for the MF methods.

Sample B

- There was no *E. coli* in the mixture. Instead there were two other coliform bacteria present, *K. pneumoniae* and *E. aerogenes*. They possess *β*-galactosidase but not *β*-glucuronidase and are thus detected as coliform bacteria.
- One high outlier was reported for coliform bacteria and one false positive result for *E. coli* when "wrong method" (tube method based on fermentation of lactose) was used. The latter result may be mixed up with that for sample C.
- The average for coliform bacteria was somewhat higher than for the MF methods.

Sample C

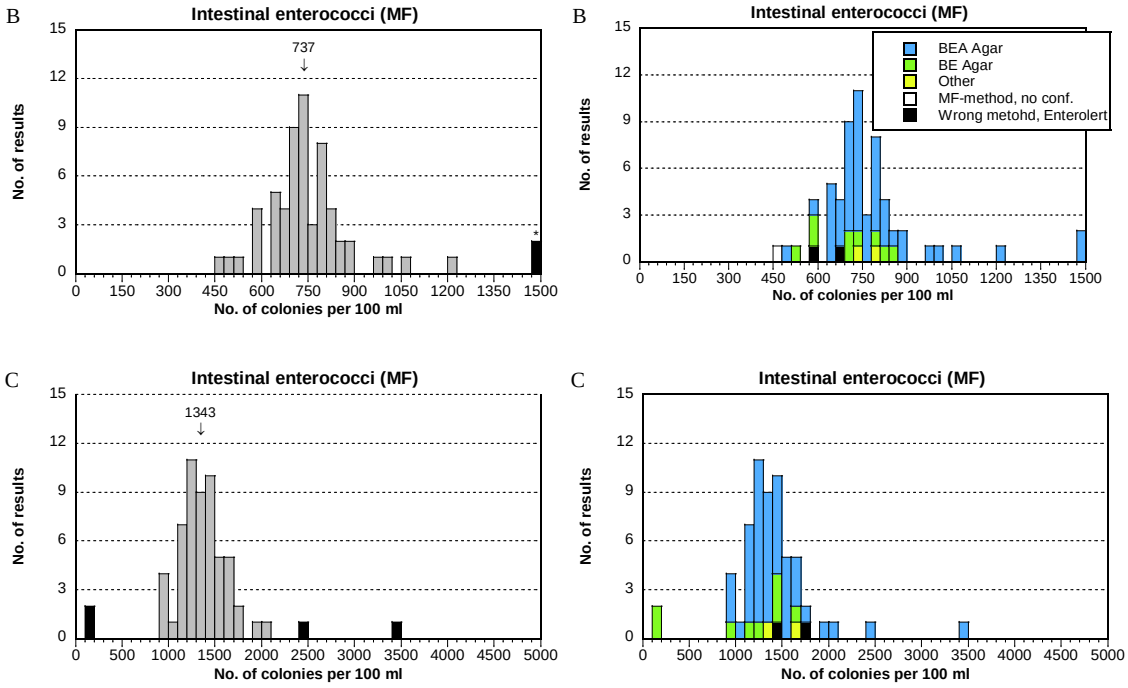
- The coliform bacteria *E. coli* and *K. oxytoca* were included. Both of them possess the enzyme *β*-galactosidase and are detected as coliform bacteria.
- Only the strain of *E. coli* has the enzyme *β*-glucuronidase and is detected as *E. coli*.
- One low outlier was present for coliform bacteria and two false negative results for *E. coli*. One of these may be due to mixing up with sample B.
- The averages were somewhat higher than for the MF methods.

Intestinal enterococci (MF)

The method used for intestinal enterococci is almost exclusively EN ISO 7899-2:2000. Only in 4 cases has another method reference, like national standards or manufacturers instruction been stated. m-Enterococcus Agar (Slanetz & Bartley), here designated m-Ent, has been used as primary medium except in 3 cases. Out of these, the method Enterolert®-DW (Idexx Inc.) has been used in one case and Enterolert®-E (Idexx Inc.) in another, in spite of not being MF methods. In both these the incubation temperature was 41 °C. In the third case, the laboratory used Rapid Enterococcus Agar at 44 °C without confirmation. In all other cases the incubation temperatures were 35, 36 or 37 °C.

Confirmation medium	**N**	**A**						**B**						**C**					
		n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>
Total	62	51	**0**	–	8	–	–	59	**737**	8	0	0	2	56	**1343**	8	0	2	2
MF method with conf.	*59*	*48*	***0***	*–*	*8*	*–*	*–*	*56*	***747***	*8*	*0*	*0*	*2*	*54*	***1335***	*8*	*0*	*2*	*2*
BEA Agar	48	38	**0**	–	7	–	–	45	**758**	8	0	0	2	45	**1337**	8	0	0	2
BE Agar	9	8	**0**	–	1	–	–	9	**691**	8	0	0	0	7	**1289**	9	0	2	0
Other/Unknown	2	2	**0**	–	0	–	–	2	**–**	–	0	0	0	2	**–**	–	0	0	0
MF method, no conf.	*1*	*1*	***0***	*–*	*0*	*–*	*–*	*1*	***–***	*–*	*0*	*0*	*0*	*1*	***–***	*–*	*0*	*0*	*0*
*Rapid method**	*2*	*2*	***0***	*–*	*0*	*–*	*–*	*2*	***–***	*–*	*0*	*0*	*0*	*2*	***–***	*–*	*0*	*0*	*0*

* Two variants of Enterolert® – no confirmation was done



The method for presumptive intestinal enterococci does not differ for the vast majority of the 62 results obtained. Method differences are, therefore, most seen in the confirmation step. Confirmation was performed by all but 3 laboratories. From the table is clear that 81 % was performed with Bile-esculin-azide agar (BEA Agar) as stated in EN ISO 7899-2:2000, 15 % was performed with Bile-esculin agar (BE Agar; without azide) and 3 % by other means. No difference can be seen for BE Agar compared to BEA Agar.

The temperature for confirmation was in 88 % of the laboratories 44 °C, in 7 % less than 44 °C and in 5 % it was 44.5 °C (the numbers are not shown in the table).

Sample A

- No enterococcus strain was included but a strain of *Lactobacillus plantarum* appeared on m-Ent with small light coloured colonies after 2 days. Also the strain of *Staphylococcus saprophyticus* will sometimes grow with small colonies.
- Eight false positive results were reported even though the colonies were small and atypical, and unlike those of intestinal enterococci. However, around 20 laboratories have reported about 5000 suspected intestinal enterococci, thus most of which were excluded after confirmation.

Sample B

- A strain of *Enterococcus hirae* was present. The distribution of the results was good with very small dispersion (see page 28). The colonies are brown-red on m-Ent and are normally confirmed without problem.
- Two incredibly high outliers were obtained.

Sample C

- A strain of *E. durans* was present. The distribution of the results was narrow and good with very small dispersion. The colonies are light brown-red on m-Ent and are normally confirmed without problem.
- Two high and two low deviating results were present.

Pseudomonas aeruginosa (MF)

EN ISO 16266:2008 with or without modification was used by 46 out of the 57 laboratories that reported results. Some laboratories have as reference stated the identical, but since long time withdrawn, CEN standard EN 12780:2002 with or without modification. Pseudalert® (Idexx Inc.) has been used in 6 cases. Incubation has in 4 cases with Pseudalert® been done at 38 °C and in 2 cases at 37 °C. For the MF methods the incubation has been done at 35, 36 or 37 °C.

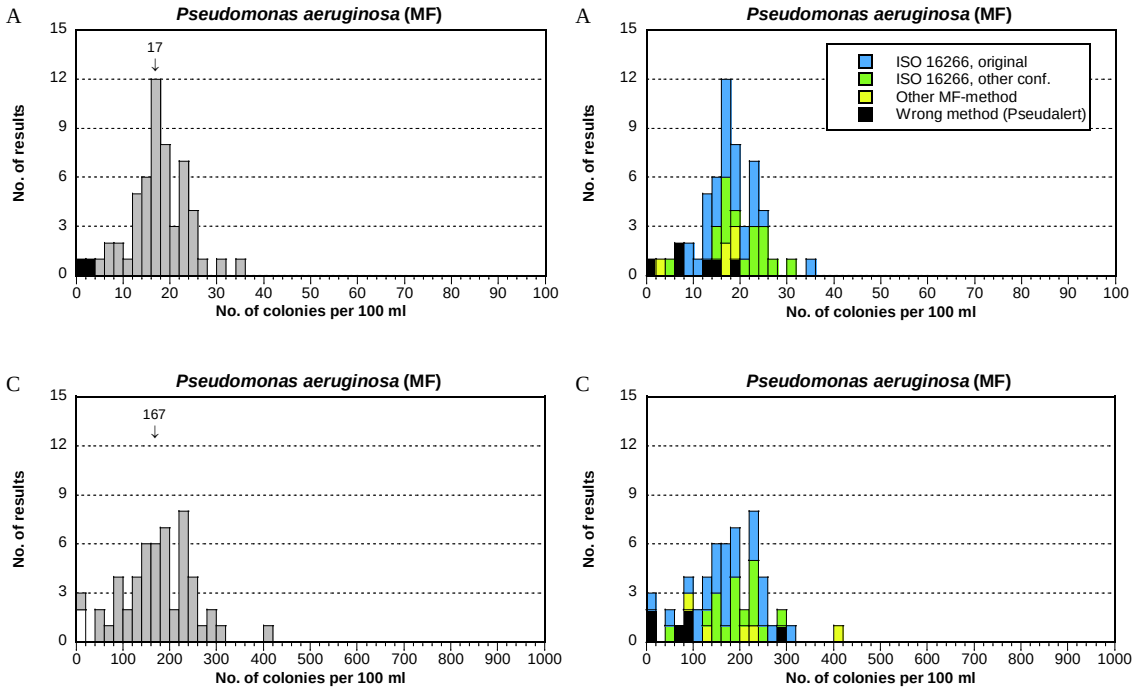
Because unhealthy substances like mercury are included, many laboratories have replaced the confirmation tests in the standard, by some other method. The major modification of the method, therefore, concerns the confirmation. When only typical yellow-green to blue-green colonies are present, no confirmation needs to be done. In those cases there is no principal difference between what is counted whether "mod." is stated for the method or not. The colonies in sample A were typical, meaning no confirmation was necessary. Those in sample C were a bit atypical as being brown-green, and the decision if confirmation would be necessary probably varied. If confirmation was done or not is therefore obscure. There is no difference between "modified" or not modified in the table.

The 5-6 results for "wrong method" in the table were obtained by use of Pseudalert®. Both for sample A and C the averages by that method were much lower than by the MF methods, while the dispersion (CV) at the same time was larger.

Standard/Method	**N**	**A**						**B**						**C**					
		n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>
Total	57	54	**17**	17	0	2	0	55	**0**	–	0	–	–	52	**167**	23	2	0	0
Membrane filtration	*51*	*49*	***18***	*16*	*0*	*1*	*0*	*49*	***0***	–	*0*	–	–	*47*	***177***	*19*	*1*	*0*	*0*
ISO 16266 [a]	29	28	**17**	16	0	0	0	28	**0**	–	0	–	–	25	**172**	19	1	0	0
ISO 16266, mod. [b]	17	17	**19**	17	0	0	0	16	**0**	–	0	–	–	17	**181**	17	0	0	0
Other	5	4	**–**	–	0	1	0	5	**0**	–	0	–	–	5	**194**	29	0	0	0
Wrong method, Pseudalert®, MPN	*6*	*5*	***11***	*24*	*0*	*1*	*0*	*6*	***0***	–	*0*	–	–	*5*	***87***	*52*	*1*	*0*	*0*

a Modification not stated for confirmation; includes EN 12780:2002

b Alternative confirmation performed, e.g. Maldi-TOF, API, phenanthroline test; includes EN 12780:2002, mod.



Sample A

- One strain of *Pseudomonas aeruginosa* with typical blue-green colonies on PACN was included. The colonies showed a clear fluorescence under UV light. No confirmation was necessary according to the standard.
- The results were well accumulated and the distribution therefore good with a small dispersion (see page. 28).
- Two low outliers were present.

Sample B

- There was no *P. aeruginosa* in the sample but instead transparent colonies of *Burkholderia cepacia*. Some laboratories reported them as suspected *P. aeruginosa*. Confirmation has probably then been done but with negative outcome.
- No false positive results were reported.

Sample C

- One strain of *P. aeruginosa* with brown-green colonies on PACN was included in the sample. The brown colour was best seen from the bottom of the agar plates. The colonies showed clear fluorescence under UV light. Normally, no confirmation was necessary as there were a greenish hue, although the brownish colour could lead to confirmation "in case of".
- The results were quite well accumulated, although there was a sort of tail with low results. The total dispersion was medium-sized.
- Two false negative results were present.

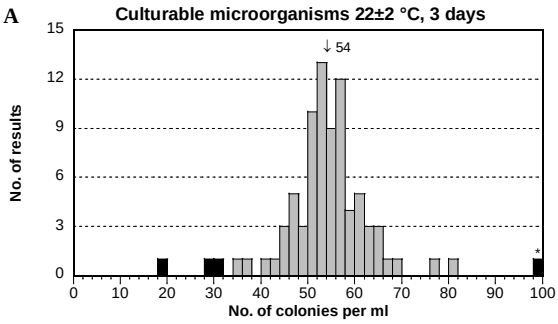
Culturable microorganisms 22 °C, 3 days

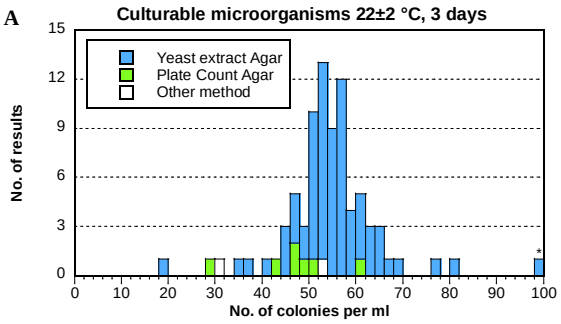
Eighty-one out of the 83 laboratories performing the analysis reported EN ISO 6222:1999 as method, which prescribes the use of Yeast extract Agar. Seven laboratories used Plate Count Agar in combination with this standard. Two laboratories used Standard Methods [5] together with Yeast extract Agar, and in one of these cases by the spread plate technique. They are included in the group "Other method" in the table. Tree more laboratories have reported the use of spread plate technique together with EN ISO 6222:1999, out of which two had an extra layer of agar topmost.

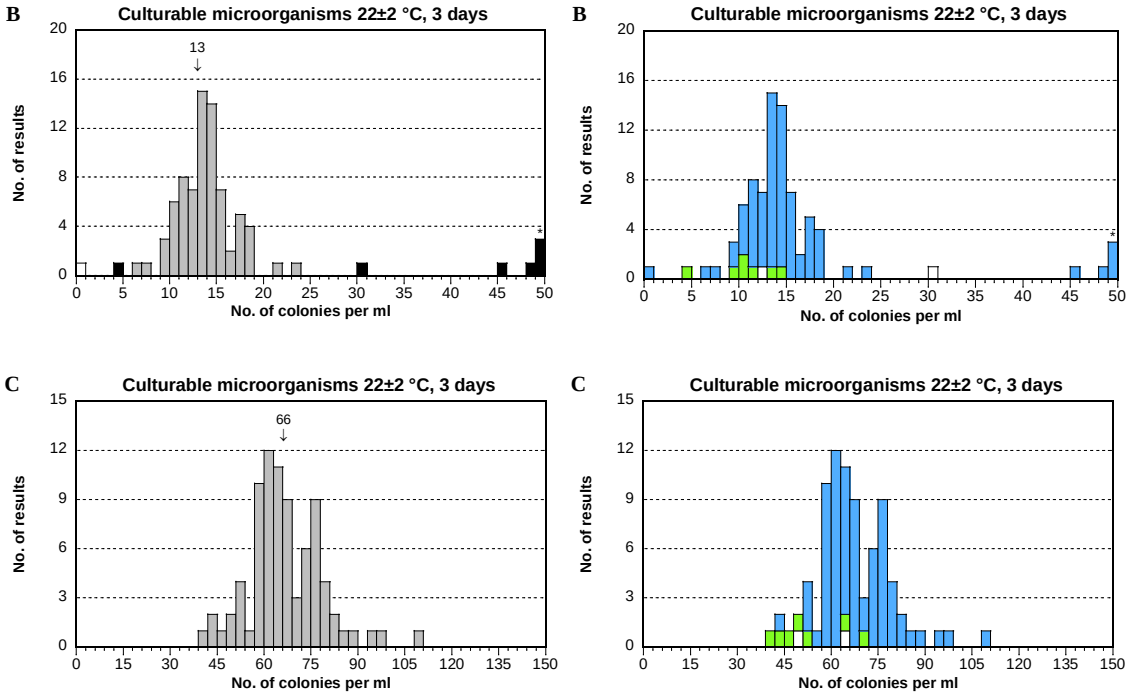
Comparisons of method variants are relevant to discuss only in connection to EN ISO 6222:1999. Results are given for culture media and magnification for reading.

There are no differences between any samples in relation to magnification at reading. For sample A, and especially for sample C, the average results were a bit lower with PCA compared to YEA.

Group of results	N	A						B						C					
		n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>
Total, all results	83	78	**54**	7	0	3	1	75	**13**	11	1	1	6	82	**66**	9	0	0	0
EN ISO 6222	*81*	*77*	***54***	*7*	*0*	*2*	*1*	*74*	***13***	*11*	*1*	*1*	*5*	*80*	***66***	*9*	*0*	*0*	*0*
Medium																			
Yeast extract Agar	74	71	**54**	7	0	1	1	68	**13**	11	1	0	5	73	**68**	8	0	0	0
Plate Count Agar	7	6	**49**	6	0	1	0	6	**11**	9	0	1	0	7	**52**	10	0	0	0
Other/Unknown	0	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Magnification																			
None	22	20	**57**	7	0	1	0	18	**14**	13	1	1	2	21	**62**	9	0	0	0
1,1–4,9×	27	27	**54**	7	0	0	0	27	**13**	11	0	0	0	27	**67**	11	0	0	0
5–11,9×	31	29	**52**	7	0	1	1	28	**13**	10	0	0	3	31	**68**	7	0	0	0
> 12×	1	1	–	–	0	0	0	1	–	–	0	0	0	1	–	–	0	0	0
Other/unknown	0	0	–	–	–	–	–	0	–	–	–	–	–	0	–	–	–	–	–
Other method	*2*	*1*	–	–	*0*	*1*	*0*	*1*	–	–	*0*	*0*	*1*	*2*	–	–	*0*	*0*	*0*







Sample A

- All strains in the sample appeared as culturable microorganisms. No particular problems seemed to be present.
- The distribution of the results was good with a very small dispersion (see page 28).
- One high outlier and 3 low outliers were obtained.

Sample B

- All the strains except *Staphylococcus capitis* will normally grow as culturable microorganisms, in one case only with <1 cfu/ml.
- The distribution of the results was normal except for the 6 high deviating results. However, the dispersion was still small for the other results.
- One false negative result, one low outlier and 5 high outliers were present.
- The majority of the high outliers were probably a result of a too high incubation temperature allowing the growth also of *S. capitis*. That strain grows well in the corresponding analysis at 36±2 °C. At what temperature it starts to become visible is not checked.

Sample C

- All the strains in the sample appeared as culturable microorganisms. No particular problems seemed to be present.
- The distribution of the results was good with a small to very small dispersion (see page 28).
- No deviating results were present.

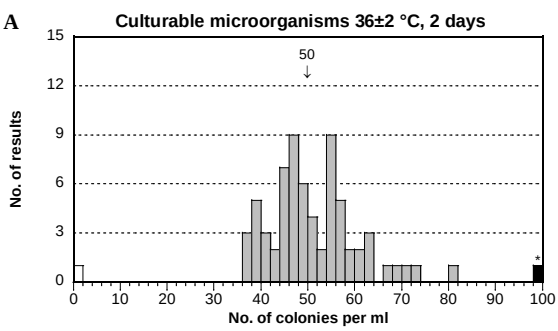
Culturable microorganisms 36 °C, 2 days

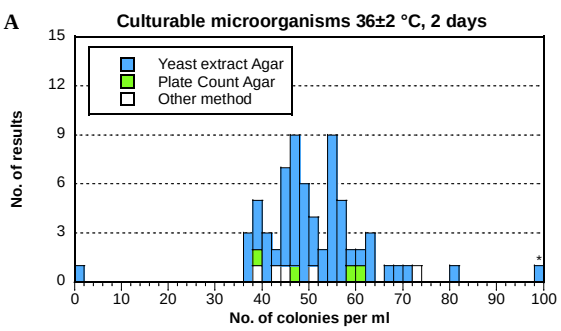
Sixty-five of the 71 laboratories have stated the use of EN ISO 6222:1999. Three of the laboratories in the group "Other method" in the table have stated Standard Methods [5], two have stated Swiss standard while the last didn't state any standard. Eight laboratories have reported Plate Count Agar, out of which 4 in combination with EN ISO 6222:1999, 2 in combination with Standard Methods and 2 together with Swiss standard. The values for PCA together with EN ISO 6222:1999 are shown as comparison in the table, despite only 4 values per sample. The results for PCA in combination with EN ISO 6222:1999 are given as comparison despite only 4 results per sample.

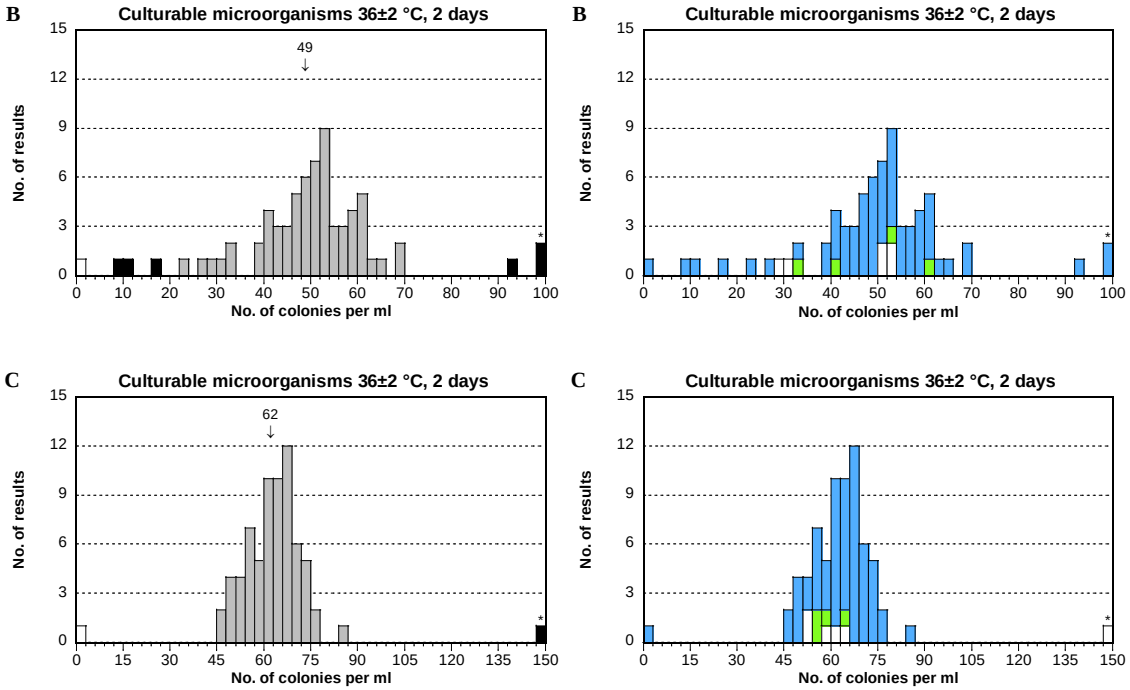
As for the analysis at 22 °C, comparisons of method variants are relevant to discuss only when EN ISO 6222:1999 was used. Also here, the results are presented in relation to culture media and magnification for reading.

No clear differences between methods could be seen in any case. For sample B and C the average results for "Other method" are somewhat lower. But it is not possible to relate that to a particular method.

Group of results	N	A						B						C					
		n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>	n	**Mv**	CV	F	<	>
Total, all results	71	67	**50**	9	1	0	1	64	**49**	10	1	3	3	68	**62**	6	1	0	1
EN ISO 6222	*65*	*62*	***50***	*9*	*1*	*0*	*1*	*58*	***49***	*10*	*1*	*3*	*3*	*63*	***63***	*6*	*1*	*0*	*0*
Medium																			
Yeast extract Agar	61	58	**50**	9	1	0	1	54	**50**	10	1	3	3	59	**63**	7	1	0	0
Plate Count Agar	4	4	**50**	10	0	0	0	4	**46**	13	0	0	0	4	**59**	4	0	0	0
Other/Unknown	0	0	–	–	–	–	–	0	–	–	–	–	-	0	–	–	–	–	–
Magnification																			
None	21	20	**50**	11	0	0	0	18	**47**	11	0	1	2	20	**61**	7	0	0	0
1,1–4,9×	24	23	**51**	8	1	0	0	21	**51**	8	1	2	0	23	**61**	7	1	0	0
5–11,9×	20	19	**49**	7	0	0	1	19	**49**	11	0	0	1	20	**65**	4	0	0	0
> 12×	0	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Other/Unknown	0	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Other method	6	5	**49**	13	0	0	0	6	**44**	13	0	0	0	5	**57**	4	0	0	1







Sample A

- All strains in the sample appeared as culturable microorganisms at 36±2 °C. No particular problems seemed to be present.
- The distribution of the results was good with a very small to small dispersion (see page 28).
- One high outlier was present.

Sample B

- All strains in the sample will grow at 36±2 °C. The considerably higher average here compared to at 22 °C is caused by the strain of *S. capitis* that grows at 36 but not at 22 °C and is present in highest concentration.
- The distribution shows, as in previous rounds (September round 2015, September round 2016 and September 2017) unexpectedly many low results. The reason for them is unclear. Possibly, some of the *S. capitis* colonies may not grow enough to be reckoned as colonies under the magnification used.
- The lowest results were identified as deviating ones. Yet the relative dispersion of the accepted results was small.
- One false negative result, 3 low and 3 high outliers were identified.

Sample C

- All strains in the sample appeared as culturable microorganisms at 36±2 °C. No particular problems seemed to be present.
- The distribution of the results was good with a very small dispersion (see page 28).
- One false negative result and one high outlier were present.

Outcome of the results and laboratory assessment

General information about reported results

The distributions of results for the respective analysis are shown in histograms. A box plot (see below) gives a summarizing image of all the results of a laboratory, except false results. The number of false results and outliers are given below the plot for each laboratory. These values are highlighted with bold text on yellow background in annex A. The limit values for lowest and highest accepted results are given for each analysis in the summarizing lines at the end of annex A, together with the measurement uncertainty of the mean.

Base for assessment of the performance

The laboratories are not grouped or ranked in relation to their performances. The assessment is basically a clear indication of the numbers of false results and outliers.

Generally, the laboratories that did not report their results in due time, have to compare their results themselves with all other laboratory's by looking in tables, figures and annex A.

Mixed up results and other practical errors

Thirteen laboratories obtained more than one deviating result. When whole samples seem to have been mixed up, the corresponding sample numbers are hatched in annex A. No laboratory seems to have mixed up samples. Instead, one laboratory may have mixed up two results for one parameter. A couple of laboratories can be suspected to have forgotten to recalculate some counts to the volume asked for. Others have reported unreasonably high results for certain analyses.

z-scores, box plots and deviating results for each laboratory

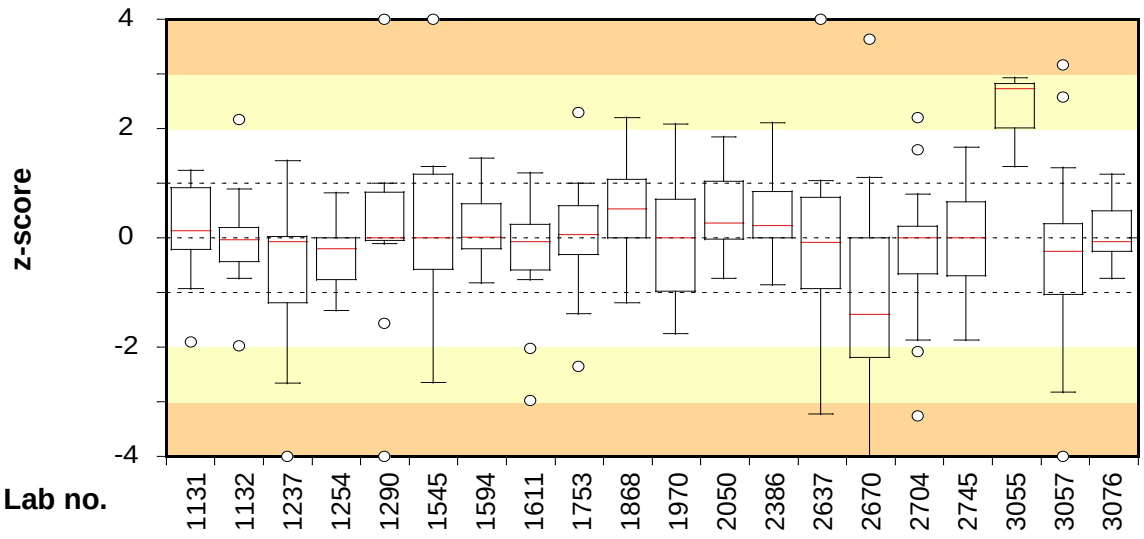
The square-root transformed results of the laboratories are calculated to standard scores, z-scores, to become comparable between analyses. They are given in annex B and used for the box plots. They are given explicitly to facilitate the follow-up process for laboratories using z-scores in control charts etc. For interpretation and calculation of z-scores, see the scheme protocol [1] and the explanation to annex A.

The z-scores are the base for the box plots. The range of the z-scores for each laboratory is shown by a rectangle (box) and lines and/or circles above and beneath the box. The smaller the range from lowest to highest value is in the plot and the more centred around zero the values are, the better is the agreement between the laboratory's results and the means from all laboratories.

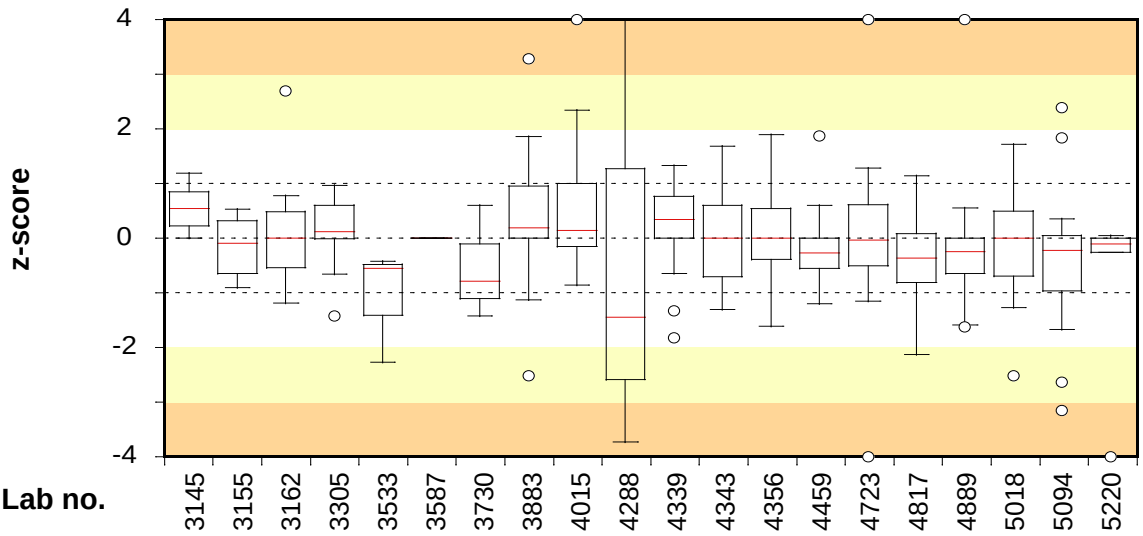
Box plots and numbers of deviating results for each participating laboratory

- *z-scores are calculated from the formula z = (x – mv) / s (see annex A).*
- *A correct result "zero" will get z = 0 when there is no target organism present.*
- *False results do not generate z-scores and are not included in 'No. of results'.*
- *The outliers are included in the plots after recalculation to standardised values with the same standard deviation (s) as the rest of the results for each parameter.*
- *z-scores > +4 and < –4 have in the plots been set to +4 and –4, respectively.*
- *The numbers of false positives and false negatives are given in the table under the plots together with the numbers of outliers.*
- *The horizontal red line in each box indicates the median for the laboratory.*
- *The box includes 25 % of the results above and below the median. The lines protruding from the box and/or the circles embrace the remaining 50 % of the results, outliers excluded.*
- *A circle is for technical reasons shown when a result is to a certain degree deviating* from the rest. This alone does not mean it is an outlier.*
- *The background is divided into coloured fields in order to simplify localization of the laboratory results.*

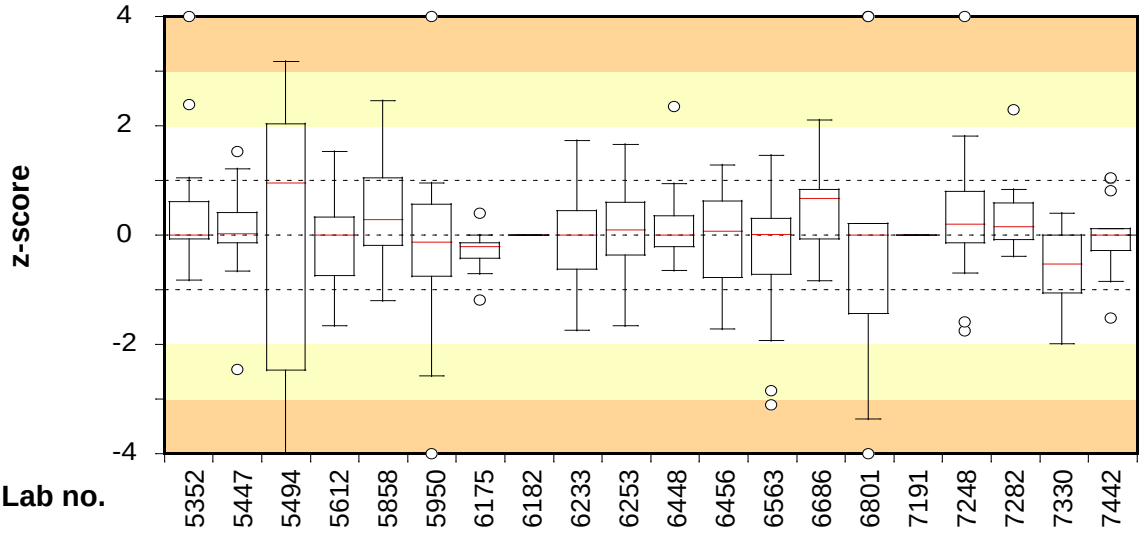
* < [smallest value of the box - 1.5 × (largest value of the box - smallest value of the box)] *or* > [largest value of the box + 1.5 × (largest value of the box - smallest value of the box)]



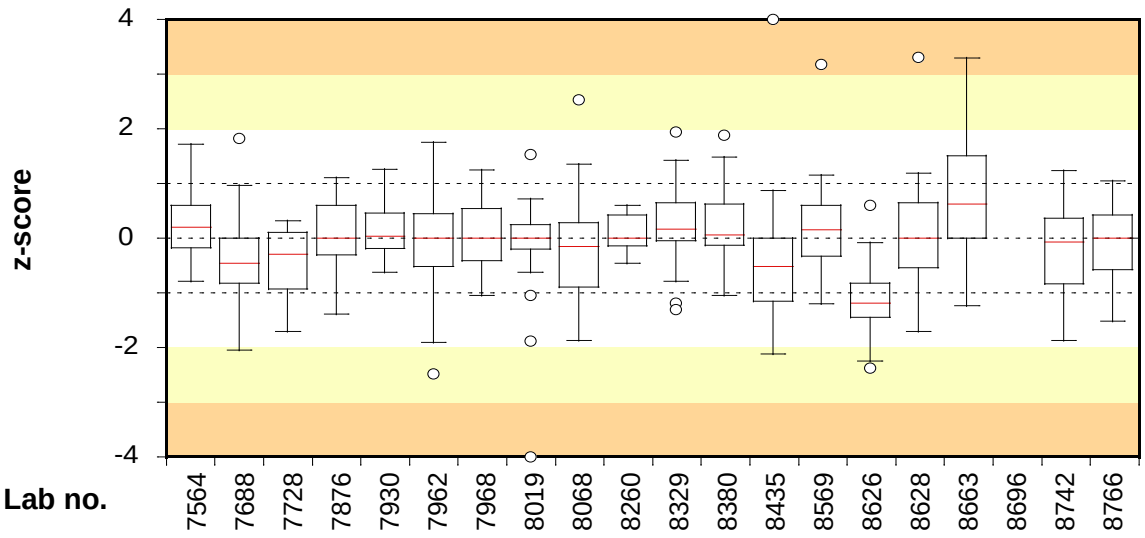
Lab no.	1131	1132	1237	1254	1290	1545	1594	1611	1753	1868	1970	2050	2386	2637	2670	2704	2745	3055	3057	3076
No. of results	9	12	21	24	17	24	24	24	24	15	18	23	24	12	18	23	9	3	21	9
False positive	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-
False negative	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-
Low outliers	-	-	1	-	1	-	-	-	-	-	-	-	-	-	3	-	-	-	1	-
High outliers	-	-	-	-	2	4	-	-	-	-	-	-	-	1	1	-	-	-	-	-



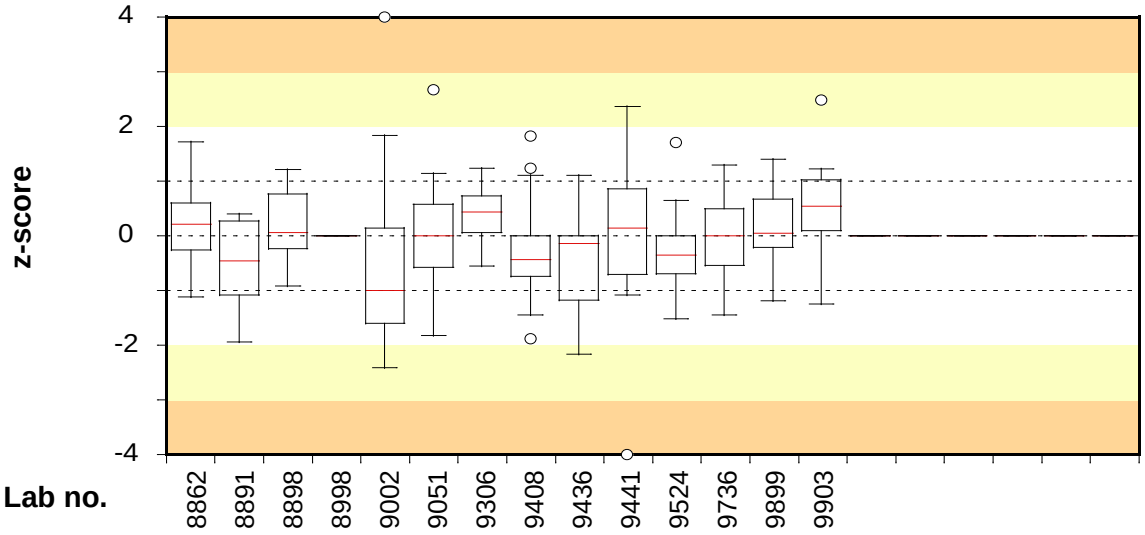
Lab no.	3145	3155	3162	3305	3533	3587	3730	3883	4015	4288	4339	4343	4356	4459	4723	4817	4889	5018	5094	5220
No. of results	6	5	18	23	3	-	3	24	12	3	24	17	24	10	12	12	23	23	15	6
False positive	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
False negative	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	-	1
Low outliers	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1
High outliers	-	-	-	-	-	-	-	-	1	1	-	-	-	-	1	-	1	-	-	-



Lab no.	5352	5447	5494	5612	5858	5950	6175	6182	6233	6253	6448	6456	6563	6686	6801	7191	7248	7282	7330	7442
No. of results	18	18	7	22	17	24	9	-	24	12	12	18	24	10	9	0	15	12	12	15
False positive	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
False negative	-	-	2	2	-	-	-	-	-	-	-	-	-	1	2	3	-	-	-	-
Low outliers	-	-	2	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-
High outliers	1	-	-	-	-	1	-	-	-	-	-	-	-	-	2	-	1	-	-	-



Lab no.	7564	7688	7728	7876	7930	7962	7968	8019	8068	8260	8329	8380	8435	8569	8626	8628	8663	8696	8742	8766
No. of results	12	23	18	24	24	21	24	24	24	9	24	24	17	18	9	16	24	4	12	24
False positive	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	1	-	1	-	-
False negative	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-
Low outliers	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
High outliers	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	4	-	-



Lab no.	8862	8891	8898	8998	9002	9051	9306	9408	9436	9441	9524	9736	9899	9903
No. of results	18	6	24	-	11	24	12	18	24	12	21	18	23	18
False positive	-	-	-	-	-	-	-	-	-	-	-	-	1	-
False negative	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Low outliers	-	-	-	-	-	-	-	-	-	1	-	-	-	-
High outliers	-	-	-	-	1	-	-	-	-	-	-	-	-	-

Test material, quality controls and processing of data

Description of the test material

This round comprised three test items with different microorganism mixtures. The test material was manufactured and freeze-dried in portions of 0.5 ml in small vials, according to the description by Peterz and Steneryd [2]. The simulated water samples were prepared by dissolving the content of the vials in 800 ml of sterile diluent. The composition and approximate concentrations in each mixture obtained at the National Food Agency are listed in table 2. The participating laboratories were assigned to perform the analyses according to the methods routinely used by them.

The test material is primarily suited to the EN ISO methods for analyses of drinking water referred to in the European Drinking water directive [4] and its updates [6]. Alternative methods and other standards may usually be used without any problem.

Table 2 *Microorganisms present in the mixtures*

Mixture [1]	**Microorganisms**	**Strain collection no.**		**cfu/100 ml** [2]
		SLV (own)	Reference [3]	
A	*Escherichia coli*	084	–	13
	Klebsiella pneumoniae	186	CCUG 45102	12
	Lactobacillus plantarum	475	CCUG 30503	8000 [4]
	Pseudomonas aeruginosa	453	CCUG 551	28
	Staphylococcus saprophyticus	013	CCUG 45100	? [5]
B	*Klebsiella pneumoniae*	537	–	360
	Enterobacter aerogenes	099	ATCC 13 048	200
	Enterococcus hirae	536	CCUG 46536	760
	Burkholderia cepacia	042	–	24
	Staphylococcus capitis	463	CCUG 35173	43 *
C	*Escherichia coli*	532	CCUG 48891	3400
	Klebsiella oxytoca	089	CCUG 43602	2100
	Enterococcus durans	078	CCUG 44816	1300
	Pseudomonas aeruginosa	569	–	300

1 The links between the mixtures and the randomised sample numbers are shown in annex A; the analyses were performed at the times given in note 1 of table 3

2 cfu = colony forming units

3 Origin or culture collection number; ATCC: American Type Culture Collection; CCUG: Culture Collection University of Gothenburg, Sweden

4 The result is from m-Enterococccus agar and comprises both *L. plantarum* and *S. saprophyticus*

5 See note 4

* Indicates cfu per ml

Quality control of the test material

It is essential to have a homogeneous mixture and a uniform volume in all vials in order to allow comparison of all freeze-dried test items derived from one mixture. The volume was checked by weighing 2 to 3 % of the number of vials produced of the mixtures. The largest differences between vials were 6, 6 and 2 mg in mixture A, B and C, respectively. The largest accepted difference is 15 mg (3 %).

Table 3 presents the results from the organizer in the form of concentration means (cfu) and the measures (I_2 and T; see reference 1) used to assess homogeneity from duplicate analyses of 10 vials from each mixture the first time the mixture is used or duplicate analyses from 5 vials in a stability check when a mixture is used a second time. The results relate to the volume that was used for counting the colonies. The

Table 3 *Contents (cfu) and measures of homogeneity (I_2 and T, see reference 1) in relevant sample volumes for the various parameters in the mixtures* [1]

Analysis parameter	**Mixture**								
Method standard for analysis	**A**			**B**			**C** [2]		
	cfu	**I_2**	**T**	**cfu**	**I_2**	**T**	**cfu**	**I_2**	**T**
Coliform bacteria (MF) *m-Endo Agar LES according to SS 028167*	26	1.1	1.5	56 [c]	1.1	1.3	56 [d]	1.1	1.3
Suspected thermotolerant colif. bact. (MF) * *m-FC Agar, 44 °C according to SS 028167*	26 [a]	– [a]	1.5	32 [c]	1.1	1.4	33 [d]	1.1	1.4
Escherichia coli (MF) *m-Endo Agar LES according to SS 028167*	13	1.1	1.8	–	–	–	34 [d]	1.9	1.6
Intestinal enterococci (MF) *m-Enterococcus Agar acc. to SS-EN ISO 7899-2:2000*	82 [b]	– [b]	2.0	76 [c]	1.0	1.3	132 [c]	1.7	1.2
Pseudomonas aeruginosa (MF) *Pseudomonas Agar base with cetrimide and nalidixic acid according to SS-EN ISO 16266:2008*	28	0.7	1.4	–	–	–	30 [c]	0.6	1.3
Culturable microorg., 2d 37 °C (pour plate) *Yeast extract Agar according to SS-EN ISO 6222:1999*	50	1.3	1.4	53	1.3	1.4	71	1.1	1.3
Culturable microorg., 3d 22 °C (pour plate) *Yeast extract Agar according to SS-EN ISO 6222:1999*	58	1.4	1.4	14	0.7	1.6	74	0.2	1.1

1 n=10 vials analysed in duplicate, normally100 ml for MF and 1 ml for pour plate, 21, 15 and 13 weeks ahead of the testing round start for the mixtures A, B and C, respectively

2 The parameter is not evaluated in the round as it consists of suspected colonies only

a Only 5 single analyses was performed – thus no value for I_2, the strains were the same as on LES

b A presumptive false positive result due to the counting of *L. plantarum* and *S. saprophyticus*; only 3 single analyses was performed – thus no value for I_2

c Determined for the volume 10 ml

d Determined for the volume 1 ml

– No target organism and thus no analysis

simultaneously higher than 2. According to that criterion, all mixtures were homogeneous regarding the assessed parameters that were about to be analysed.

Processing of numerical results

Most histograms have "tails" in either or both directions, due to values that do not belong to a normal distribution. Calculations are performed after square root transformations of the results that give better normal distributions by decreasing the significance of the high deviating results. Very deviating values are still present in most analyses and are identified as outliers (black bars). False negative results are presented with white bars in the histograms.

Outliers are identified by use of Grubbs' test according to a modification by Kelly [3]. A level of 1 % is set as the risk to incorrectly assess a result as being an outlier. Although the method is objective, there is a prerequisite that the results are normally distributed in order to obtain correct outliers at the 1 % level. A zero result that is a low outlier is considered a false negative result. In special situations, e.g. when many zero results are reported and in some borderline cases, a few subjective adjustments are made in order to set the right limits based on the knowledge of the mixture's content. False results and outliers are not included in the calculations of mean values and measures of distribution.

The coefficient of variation (CV) for square root transformed results is given as a measure of dispersion. When the dispersion is <10 % it is regarded as very small, 10–20 % as small, 20–30 % as medium, 30–40 % as large and >40 % as very large.

The calculation of uncertainty of measurement of the assigned value is described in the scheme protocol [1]. The assigned value for an analysis is calculated from the square root transformed results and is the square root of "Mean" in Annex A. It is there denoted as *mv*. Hence, also the measurement uncertainty will be expressed as a square root value. The standard uncertainty of measurement (u) correspond to the standard deviation of the assigned value (s) divided by the number of results square-root transformed, i.e.: $u = s/\sqrt{n_{mv}}$ where n_{mv} is the number of results in annex A, except the deviating ones. Here is the relative uncertainty (u_{rel}) used and expressed as per cent after division by the mean value *mv* and multiplication by 100.

More about result processing and recommendations on follow-up work are given in the scheme protocol [1]. A PDF of that document is available on the website https://www2.slv.se/absint.

References

1. Anonymous 2017, corrected version 2018. Scheme protocol, Microbiology, Drinking water & Food, 5th ed. National Food Agency, Sweden.
2. 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.
3. Kelly, K. 1990. Outlier detection in collaborative studies. J. Assoc. Off. Chem. 73:58-64.
4. Anonymous 1998. Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption. Official Journal of the European Communities. 5.12.98, L 330/32-54 *(national translations available).*
5. Standard Methods for the Examination of Water and Wastewater, http://www.standardmethods.org/
6. Anonymous 2015. Commission Directive (EU) 2015/1787 of 6 October 2015 amending Annexes II and III to Council Directive 98/83/EC on the quality of water intended for human consumption. Official Journal of the European Union. 7.10.2015, L 260/6-17 *(national translations available).*

Annex A *Results of the participants, cfu/100 ml (see also the note). Susp. = suspected on membrane filter before confirmation. Results given as <1, <2, <10 and <100 are treated as zero. The fields with other results given as < 'value' and results given as > 'value' are* ***yellow****, and those results are not included in calculations or evaluations. This is also valid for results in* ***shaded columns****. A* ***hyphen*** *indicate that no result has been reported.* ***Figures written in bold in yellow fields*** *indicate outliers, false positive and false negative results.* ***Underlined zero values*** *indicate results characterized as 'False negative ?'.* ***Crossed out sample numbers*** *in a row indicate that the samples probably are mixed up. False positive and false negative*

Lab no.	Sample	Suspected coliform bacteria (MF)			Coliform bacteria (MF)			Susp. thermotolerant coliform bact. (MF)			*E. coli* (MF)			Coliform bacteria ("rapid" MPN)			*E. coli* ("rapid" MPN)		
	A B C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1131	1 2 3	-	-	-	-	-	-	-	-	-	-	-	-	18	488	6131	6	<1	3873
1132	3 1 2	-	-	-	-	-	-	-	-	-	-	-	-	29	443	4106	21	0	3076
1237	2 1 3	-	-	-	33	450	3800	-	-	-	12	<1	3000	15	480	**>2420**	8	<1	**>2420**
1254	1 3 2	21	370	3300	21	370	3300	-	-	-	11	0	2000	24	610	4000	9	0	2600
1290	3 1 2	-	-	-	27	**4680**	4409	-	-	-	13	<1	3000	-	-	-	-	-	-
1545	2 1 3	26	400	5700	20	400	5700	12	220	2500	9	0	2500	10	430	4800	6	0	3500
1594	1 2 3	20	490	5300	20	490	5300	15	350	2400	10	0	3600	27	620	4700	12	0	3900
1611	1 3 2	22	550	4200	22	550	4200	21	383	2870	9	0	3400	31	548	4082	15	0	2738
1753	1 3 2	-	-	-	23	480	5100	-	-	-	12	0	3800	26	613	6130	15	0	5170
1868	1 3 2	28	527	4900	28	527	4900	-	-	-	18	0	4900	25	795	4350	10	0	4350
1970	3 1 2	33	370	5100	33	370	5100	33	370	5100	21	0	3700	-	-	-	-	-	-
2050	2 3 1	-	-	-	28	620	6300	-	-	-	13	0	4800	23	499	4722	14	0	3703
2386	1 2 3	26	480	5000	26	480	5000	-	-	-	12	0	3600	22	782	6590	9	<1	4290
2637	3 1 2	-	-	-	-	-	-	-	-	-	-	-	-	29	480	5600	16	<1	3400
2670	3 2 1	6	420	2390	**6**	420	2390	6	420	0	6	0	2390	-	-	-	-	-	-
2704	3 1 2	-	-	-	23	**<1**	5200	-	-	-	12	<1	5200	34	453	5300	12	<1	3600
2745	2 1 3	15	620	4600	15	620	4600	15	620	4600	8	0	4600	-	-	-	-	-	-
3055	3 2 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3057	3 2 1	-	-	-	41	350	3400	27	220	<100	27	<10	**<100**	17	240	**30**	17	**240**	**<2**
3076	1 2 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3145	2 3 1	-	-	-	-	-	-	-	-	-	-	-	-	31	613	5172	15	0	3448
3155	3 2 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3162	2 3 1	-	-	-	-	-	-	-	-	-	-	-	-	18	866	4106	8	0	3076
3305	2 3 1	29	530	3000	29	530	3000	-	-	-	15	<1	3000	24	500	5000	12	<1	3600
3533	1 3 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3587	3 1 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3730	3 1 2	28	800	5400	-	-	-	21	300	3000	-	-	-	-	-	-	-	-	-
3883	3 1 2	20	450	5400	20	450	5400	-	-	-	10	0	3200	32	536	7270	16	0	6130
4015	2 3 1	-	-	-	-	-	-	-	-	-	-	-	-	22	**1780**	5250	9	0	3500
4288	3 1 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4339	1 3 2	28	560	5100	28	560	5100	15	260	3000	15	0	2000	32	440	4900	15	0	2800
4343	3 1 2	-	-	-	-	-	-	-	-	-	-	-	-	26	687	6867	13	0	4611
4356	2 3 1	29	540	4000	29	540	4000	29	210	2000	20	0	2400	26	517	3255	13	0	2419
4459	3 2 1	-	-	-	-	-	-	-	-	-	-	-	-	36	387	**>2420**	**<0**	**<0**	2420
4723	2 1 3	-	-	-	-	-	-	-	-	-	-	-	-	24	461	6488	10	0	4106
4817	2 3 1	-	-	-	18	260	4000	18	160	3090	-	-	-	-	-	-	-	-	-
4889	2 1 3	-	-	-	23	300	3900	-	-	-	11	0	2600	19	350	3900	14	0	2400
5018	2 1 3	35	530	5360	35	530	2144	-	-	-	18	0	**0**	18	548	4840	11	0	2420
5094	3 1 2	-	-	-	21	360	1710	-	-	-	6	0	1200	-	-	-	-	-	-
5220	3 1 2	-	-	-	-	-	-	-	-	-	-	-	-	22	517	**> 2419**	11	0	**> 2419**
5352	3 1 2	-	-	-	24	390	5000	-	-	-	14	0	3000	-	-	-	-	-	-
5447	3 1 2	-	-	-	24	490	4400	-	-	-	12	0	1300	-	-	-	-	-	-
5494	2 1 3	-	-	-	**0**	**10**	**40**	-	-	-	-	-	-	-	-	-	-	-	-
5612	3 2 1	26	480	4900	26	480	**0**	13	194	2600	13	0	**0**	19	340	5300	11	0	3600
5858	1 2 3	-	-	-	-	-	-	-	-	-	-	-	-	25	630	3640	13	0	2710
5950	3 2 1	29	536	3600	29	536	3600	25	355	2700	10	<1	2700	19	579	2419	14	<1	2419
6175	3 1 2	-	-	-	-	-	-	-	-	-	-	-	-	22	**>200**	**>200**	8	0	**>200**
6182	1 2 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6233	2 1 3	16	410	4600	16	410	4600	-	-	-	8	0	3600	30	541	4106	19	0	3076
6253	1 3 2	-	-	-	-	-	-	-	-	-	-	-	-	20	340	7000	11	0	4200
6448	3 2 1	-	-	-	30	510	3900	-	-	-	10	0	2500	-	-	-	-	-	-
6456	1 2 3	-	-	-	24	460	4900	-	-	-	7	0	**3300**	14	670	5900	8	0	2700
6563	3 2 1	25	191	5500	25	191	5500	25	191	5500	15	<1	4400	25	532	6300	12	<1	3773
6686	3 2 1	-	-	-	-	-	-	-	-	-	-	-	-	27.1	450	**>2000**	15	<1	**<1**
6801	2 1 3	17	2400	44	17	**2400**	**18**	-	-	-	**0**	0	**0**	-	-	-	-	-	-
7191	2 3 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7248	1 2 3	130	290	6400	**130**	290	6400	20	360	2100	9	0	3200	26	613	5300	16	0	3260
7282	1 2 3	-	-	-	-	-	-	-	-	-	15	0	2865	-	-	-	-	-	-
7330	3 2 1	-	-	-	-	-	-	-	-	-	9	0	2153	-	-	-	-	-	-
7442	1 3 2	-	-	-	25	532	4328	-	-	-	12	0	2982	24	637	3336	16	0	2655
7564	3 2 1	-	-	-	35	490	4000	-	-	-	14	<1	2400	-	-	-	-	-	-
7688	2 1 3	-	-	-	18	370	4300	-	-	-	5	0	2500	25	461	4350	12	0	2610
7728	3 2 1	-	-	-	23	480	4000	-	-	-	6	0	3200	-	-	-	-	-	-
7876	2 3 1	19	477	5300	19	477	5300	22	320	1920	7	<1	3400	30	365	4821	15	<1	2922
7930	1 3 2	21	430	4100	21	430	4100	-	-	-	10	<1	3100	25	480	5500	16	<1	3500
7962	3 1 2	27	470	5000	27	470	5000	20	240	2600	16	0	4000	15	488	5170	6	0	2420
7968	1 2 3	22	540	4200	22	540	4200	22	240	1965	11	0	2650	28	470	4838	15	0	2598
8019	1 2 3	21	470	4200	21	470	4200	22	310	3700	12	0	2700	25	591	5040	12	0	3640
8068	1 2 3	-	-	-	15	400	3500	-	-	-	8	0	3500	15	370	3700	11	0	2600
8260	1 3 2	22	491	4250	22	491	4250	-	-	-	11	<1	2650	-	-	-	-	-	-
8329	3 1 2	29	540	4600	29	540	4600	-	-	-	13	0	3200	25	517	5070	8	0	3180
Mean					**24**	**447**	**4343**				**12**	**0**	**3028**	**23**	**512**	**4916**	**12**	**0**	**3247**
CV (%)					12	11	12				17	-	14	13	11	12	15	-	11

values are excluded, as well as other outliers, in the summarizing calculated results at the end of the table. The mean value (Mean) is the square of the mean value for the square root transformed results (mv). The coefficient of variation (CV) is the standard deviation (s) in percentage of the mean value for the square root transformed results. As means to calculate the z-values of your own, the appropriate values of mv and s are given at the end of the table. The x-values are obtained as the square roots of the reported results, respectively. z = (x - mv) / s. $u_{rel,mv}$ *is the relative standard uncertainty of mv in per cent. For calculation see the scheme protocol [1]; also briefly described in the text.*

Susp. intestinal enterococci (MF)			Intestinal enterococci (MF)			Susp. *Pseudomonas aeruginosa* (MF)			*Pseudomonas aeruginosa* (MF)			Total plate count 22 °C, 3 days #			Total plate count 36±2 °C, 2 days #			Lab no.
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
-	-	-	-	-	-	-	-	-	-	-	-	55	17	77	-	-	-	**1131**
0	730	940	0	730	940	-	-	-	-	-	-	53	14	67	-	-	-	**1132**
-	-	-	<1	690	**120**	-	-	-	5	**>2420**	41	60	13	47	60	52	56	**1237**
4100	660	1200	0	660	1200	17	0	160	17	0	160	52	15	63	44	53	61	**1254**
-	-	-	**45**	**70000**	1319	-	-	-	23	<1	164	54	13	78	37	**10**	69	**1290**
0	720	1600	0	720	1600	22	0	200	22	0	200	**110**	**288**	64	**121**	**335**	73	**1545**
0	810	1300	0	810	1300	22	0	150	22	0	150	54	11	84	48	50	67	**1594**
0	743	1465	0	743	1465	16	0	138	16	0	138	51	6	68	46	42	47	**1611**
3500	770	1080	0	770	1080	-	-	-	6	0	77	54	14	60	47	45	66	**1753**
-	-	-	-	-	-	-	-	-	-	-	-	58	10	68	-	-	-	**1868**
0	840	1400	0	840	1400	17	0	180	17	0	180	47	9	49	39	33	56	**1970**
-	-	-	**27**	745	1700	-	-	-	13	0	300	56	14	63	45	51	77	**2050**
7100	670	1370	0	670	1370	18	22	250	18	0	250	64	13	62	57	62	68	**2386**
<1	880	1400	-	-	-	-	-	-	-	-	-	50	**48**	64	39	22	45	**2637**
0	880	970	0	880	970	10	0	40	10	0	40	**28**	**4**	44	38	**92**	60	**2670**
-	-	-	<1	710	960	-	-	-	7	<1	10	46	11	62	40	52	59	**2704**
-	-	-	-	-	-	-	-	-	-	-	-	59	13	58	-	-	-	**2745**
-	-	-	-	-	-	-	-	-	-	-	-	76	23	82	-	-	-	**3055**
-	-	-	<1	770	1210	-	-	-	17	<1	146	63	10	57	48	52	50	**3057**
-	-	-	-	-	-	-	-	-	13	0	150	63	13	75	48	54	57	**3076**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**3145**
-	-	-	-	-	1150	-	-	-	19	-	-	-	-	-	55	48	57	**3155**
35	660	1264	0	630	1227	14	0	230	14	0	230	57	14	75	46	57	66	**3162**
4	800	1200	**4**	800	1200	19	25	190	19	<1	190	60	13	74	55	59	61	**3305**
-	-	-	-	-	-	-	-	-	-	-	-	50	12	42	-	-	-	**3533**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**3587**
-	-	-	-	-	-	-	-	-	-	-	-	44	11	73	-	-	-	**3730**
0	810	1490	0	810	1490	23	22	180	23	0	180	46	13	68	62	27	64	**3883**
5318	797	1320	0	797	1320	-	-	-	-	-	-	52	18	96	-	-	-	**4015**
-	-	-	-	-	-	-	-	-	-	-	-	**30**	**30**	50	-	-	-	**4288**
150	530	1400	0	530	1400	22	0	230	22	0	230	58	14	68	56	53	71	**4339**
4536	809	1191	**36**	809	1191	-	-	-	12	0	81	45	15	74	41	45	60	**4343**
0	730	1180	0	730	1180	21	0	280	21	0	280	53	11	61	54	49	69	**4356**
-	-	-	-	-	-	-	-	-	-	-	-	50	12	62	50	47	67	**4459**
4500	800	1100	0	718	1100	-	-	-	-	-	-	**18**	**57**	65	-	-	-	**4723**
<10	750	<10	-	-	-	-	-	-	19	<1	180	48	11	65	46	61	59	**4817**
-	-	-	0	740	**3400**	-	-	-	20	0	**0**	50	9	62	46	49	64	**4889**
0	590	1220	0	590	1220	24	0	220	24	0	220	51	10	70	58	41	65	**5018**
0	710	1130	0	710	1130	-	-	-	-	-	-	52	21	64	51	69	65	**5094**
0	727	1120	-	-	-	4	0	30	**1**	0	**0**	-	-	-	-	-	-	**5220**
-	-	-	0	640	**2400**	-	-	-	34	0	170	54	13	76	55	60	56	**5352**
5200	800	1200	0	800	1200	25	0	220	25	0	220	53	18	62	54	43	64	**5447**
-	-	-	-	-	-	-	-	-	-	-	-	80	**0**	80	80	40	70	**5494**
-	-	-	0	800	1460	-	-	-	13	0	110	55	18	57	47	46	50	**5612**
760	1070	1470	**18**	1070	1470	16	19	150	16	0	147	67	14	95	66	60	55	**5858**
4300	645	1282	<1	645	1282	16	<1	250	16	<1	250	37	**45**	65	45	**8**	67	**5950**
-	-	-	-	-	-	-	-	-	-	-	-	53	12	64	44	53	60	**6175**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**6182**
0	830	1345	0	830	1345	14	0	260	14	0	260	63	13	51	44	50	49	**6233**
-	-	-	0	680	1400	-	-	-	-	-	-	61	14	68	-	-	-	**6253**
-	-	-	-	-	-	-	-	-	17	0	400	-	-	-	50	50	63	**6448**
-	-	-	-	-	-	-	-	-	-	-	-	57	17	66	56	57	51	**6456**
3800	745	1000	<1	735	948	19	14	123	19	<1	123	35	14	52	40	41	64	**6563**
<1	570	1200	-	-	-	-	-	-	-	-	-	48	13	76	71	65	68	**6686**
-	-	-	-	-	-	3	0	91	**3**	0	91	-	-	-	-	51	**5000**	**6801**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0**	**0**	**0**	**7191**
-	-	-	-	-	-	-	-	-	-	-	-	52	9	75	-	-	-	**7248**
0	718	1465	0	718	1465	19	0	220	19	0	220	-	-	-	73	53	59	**7282**
0	695	1130	0	695	1130	17	0	200	17	0	200	-	-	-	43	31	52	**7330**
-	-	-	-	-	-	-	-	-	-	-	-	53	12	60	-	-	-	**7442**
-	-	-	-	-	-	-	-	-	-	-	-	55	14	57	57	55	62	**7564**
0	690	1500	-	690	1500	-	-	-	12	0	133	48	13	58	68	59	54	**7688**
-	-	-	0	570	1400	-	-	-	14	0	120	45	14	56	36	40	63	**7728**
5300	777	1600	<1	777	1600	16	<1	259	16	<1	259	60	12	68	46	48	64	**7876**
<1	790	1300	<1	790	1300	19	<1	280	19	<1	280	55	13	76	55	47	72	**7930**
90	880	1350	**90**	880	1350	19	0	160	-	0	-	51	7	60	42	68	61	**7962**
0	740	1500	0	740	1500	22	0	190	22	0	190	56	11	60	62	53	54	**7968**
0	810	129	0	810	**129**	17	0	173	17	0	173	41	18	64	48	39	68	**8019**
-	-	-	0	710	1500	-	-	-	26	0	180	57	13	61	62	42	84	**8068**
-	-	-	-	-	-	-	-	-	-	-	-	57	15	73	-	-	-	**8260**
5300	995	1460	0	995	1460	-	-	-	15	0	81	65	11	70	49	59	74	**8329**
			0	**737**	**1343**				**17**	**0**	**167**	**54**	**13**	**66**	**50**	**49**	**62**	**Mean**
			-	8	8				17	-	23	7	11	9	9	10	6	**CV (%)**

Lab no.	Sample	Suspected coliform bacteria (MF)			Coliform bacteria (MF)			Susp. thermotolerant coliform bact. (MF)			*E. coli* (MF)			Coliform bacteria ("rapid" MPN)			*E. coli* ("rapid" MPN)		
	A B C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
8380	2 1 3	24	460	6000	24	460	6000	-	-	-	14	0	4200	22	550	4800	10	0	3500
8435	3 2 1	-	-	-	**6200**	280	3440	10	0	1050	11	0	2500	-	-	-	-	-	-
8569	3 2 1	29	510	4800	29	510	4800	-	-	-	8	0	2600	26	548	9208	12	0	2420
8626	1 2 3	20	440	2960	20	440	**0**	14	440	0	14	**396**	**0**	-	-	-	-	-	-
8628	1 3 2	-	-	-	28	350	3700	21	0	0	10	0	**0**	-	-	-	-	-	-
8663	3 1 2	42	500	5400	38	500	5400	19	310	2700	17	0	2700	35	390	5500	19	0	2400
8696	1 3 2	-	15400	-	-	**15400**	-	-	-	-	-	**6200**	-	-	-	-	-	-	-
8742	1 3 2	-	-	-	15	460	4000	-	-	-	6	<1	2000	-	-	-	-	-	-
8766	3 1 2	31	309	4800	28	309	4800	29	327	2700	13	0	3400	20	548	5794	10	0	3873
8862	2 1 3	15	491	1400	25	491	4700	-	-	-	10	0	3300	17	650	4198	11	0	2785
8891	1 3 2	-	-	-	19	275	3300	-	-	-	-	-	-	-	-	-	-	-	-
8898	3 1 2	31	564	5454	31	564	5454	-	-	-	12	0	3909	20	544	4610	10	0	3654
8998	3 2 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9002	3 1 2	-	-	-	**3100**	650	2600	-	-	-	8	0	1900	-	-	-	-	-	-
9051	2 1 3	-	-	-	27	531	3800	-	-	-	16	0	**2100**	28	485	4090	10	0	2747
9306	1 3 2	-	-	-	-	-	-	-	-	-	-	-	-	26	581	5753	10	0	4195
9408	1 3 2	-	-	-	-	-	-	-	-	-	-	-	-	20	416	4106	9	<1	2909
9436	2 3 1	20	464	4300	20	464	4300	26	218	2700	10	0	2900	12	464	3080	6	0	2414
9441	1 3 2	-	-	-	-	-	-	-	-	-	-	-	-	34	400	4500	22	<1	2500
9524	1 3 2	-	-	-	19	480	3900	-	-	-	10	<1	3000	15	441	4950	9	<1	3740
9736	2 3 1	-	-	-	-	-	-	-	-	-	-	-	-	17	579	4902	10	0	3635
9899	1 2 3	28	1119	5900	28	524	5900	-	-	-	16	0	4100	27	471	4106	15	0	3076
9903	3 2 1	27	332	5636	27	332	5636	26	470	5250	13	0	4050	-	-	-	-	-	-
n		38	39	38	63	64	63	26	26	26	62	63	62	60	59	55	60	60	57
Min		6	191	44	0	0	0	6	0	0	0	0	0	10	240	30	0	0	0
Max		130	15400	6400	6200	15400	6400	33	620	5500	27	6200	5200	36	1780	9208	22	240	6130
Median		26	490	4850	24	477	4328	21	305	2650	12	0	3000	24.5	508.5	4870	12	0	3180
Mean					**24**	**447**	**4343**				**12**	**0**	**3028**	**23**	**512**	**4916**	**12**	**0**	**3247**
CV (%)					12	11	12				17	-	14	13	11	12	15	-	11
False positive					0	0	0				0	2	0	0	0	0	0	1	0
False negative					1	1	2				1	0	6	0	0	0	1	0	2
Outliers, low					1	1	2				0	0	0	0	0	1	0	0	0
Outliers, high					3	3	0				0	0	0	0	1	0	0	0	0
Low limit OK		6	191	44	15	191	1710	6	0	0	5	0	1200*	10	240	2419	6	0	2400
High limit OK		130	15400	6400	41	650	6400	33	620	5500	27	0	5200	36	866	9208	22	0	6130
mv *(√Mean)*					4.939	21.153	65.902				3.396	0.000	55.025	4.822	22.621	70.111	3.450	0.000	56.980
s *(CV*mv/100)*					0.568	2.363	7.792				0.568	0.000	7.739	0.628	2.530	8.132	0.524	0.000	6.487
$u_{rel,mv}$ (%) *(100*s/ √n_{mv}/mv)*					1.5	1.5	1.5				2.1		1.9	1.7	1.5	1.6	2.0		1.5
x *(√Result)*																			
z *([x-mv]/s)*																			

 # cfu/ml

* The calculated results and acceptance limits are calculated without all the deviating result. However, dependent on method, some of the 6 zero results must be judged as acceptable while others are true false negative results.

Susp. intestinal enterococci (MF)			Intestinal enterococci (MF)			Susp. *Pseudomonas aeruginosa* (MF)			*Pseudomonas aeruginosa* (MF)			Total plate count 22 °C, 3 days #			Total plate count 36±2 °C, 2 days #			Lab no.
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
0	720	1200	0	720	1200	30	0	220	30	0	220	52	16	69	54	39	72	**8380**
-	-	-	0	500	1100	9	0	160	9	0	-	50	12	60	57	58	51	**8435**
4100	650	1270	0	650	1270	-	-	-	-	-	-	56	16	80	-	-	-	**8569**
-	-	-	-	-	-	-	-	-	-	-	-	46	10	41	38	29	52	**8626**
-	-	-	**50**	1200	1500	-	-	-	18	0	170	61	12	58	36	48	72	**8628**
3200	710	1600	0	710	1600	25	0	220	25	0	220	68	15	110	46	60	77	**8663**
-	96400	-	-	**96400**	-	-	-	-	-	-	-	-	**2E+05**	-	-	**2E+05**	-	**8696**
-	-	-	-	-	-	-	-	-	-	-	-	53	17	63	59	49	67	**8742**
120	655	1342	0	655	1342	21	0	100	21	0	100	46	13	59	44	60	60	**8766**
5100	964	1509	0	964	1509	-	-	-	-	-	-	57	15	73	-	-	-	**8862**
-	-	-	-	-	-	-	-	-	-	-	-	57	14	67	-	-	-	**8891**
0	660	1315	0	660	1315	25	0	153	25	0	153	52	15	77	52	51	55	**8898**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**8998**
-	-	1100	0	470	-	-	-	-	-	-	-	42	14	52	-	-	-	**9002**
-	-	-	0	800	2000	-	-	-	8	0	98	59	13	59	61	50	61	**9051**
-	-	-	-	-	-	-	-	-	-	-	-	57	17	75	54	46	63	**9306**
-	-	-	0	570	1600	14	0	150	14	0	150	51	17	89	52	44	48	**9408**
118	727	1600	0	727	1600	16	0	227	16	0	227	53	10	53	55	33	69	**9436**
-	-	-	-	-	-	-	-	-	-	-	-	57	14	78	49	**16**	68	**9441**
-	-	-	<1	583	1750	-	-	-	-	-	-	51	11	58	47	52	60	**9524**
4182	800	1236	0	800	1236	14	0	191	14	0	191	64	14	57	38	47	67	**9736**
5800	743	1286	**35**	743	1286	16	0	177	16	0	177	54	10	72	45	55	69	**9899**
0	869	1950	0	869	1950	22	0	245	22	0	245	56	15	81	51	57	66	**9903**
47	48	48	59	61	60	37	37	37	56	55	54	82	83	82	69	71	70	**n**
0	530	0	0	470	120	3	0	30	1	0	0	18	0	41	0	0	0	**Min**
7100	96400	1950	90	96400	3400	30	25	280	34	0	400	110	2E+05	110	121	2E+05	5000	**Max**
0	744	1293	0	730	1331	18	0	190	17	0	178.5	54	13	64.5	49	50	63	**Median**
			0	**737**	**1343**				**17**	**0**	**167**	**54**	**13**	**66**	**50**	**49**	**62**	**Mean**
			-	8	8				17	-	23	7	11	9	9	10	6	**CV (%)**
			8	0	0				0	0	0	0	0	0	0	0	0	**False pos.**
			0	0	0				0	0	2	0	1	0	1	1	1	**False neg.**
			0	0	2				2	0	0	3	1	0	0	3	0	**Outliers <**
			0	2	2				0	0	0	1	6	0	1	3	1	**Outliers >**
0	530	0	0	470	940	3	0	30	5	0	10	35	6	41	36	22	45	**Low limit**
7100	96400	1950	0	1200	2000	30	25	280	34	0	400	80	23	110	80	69	84	**High limit**
			0.000	27.153	36.641				4.130	0.000	12.931	7.348	3.632	8.115	7.082	6.992	7.880	**mv**
			0.000	2.265	3.030				0.714	0.000	3.004	0.502	0.398	0.720	0.637	0.715	0.507	**s**
				1.1	1.1				2.4		3.2	0.8	1.3	1.0	1.1	1.3	0.8	**$u_{rel,mv}$ (%)**
																		x
																		z

Annex B *z-scores calculated from the laboratory results. Susp. = Suspected on the membrane filters before confirmation. z = (x - mv) / s. z-scores are calculated also for outliers (excluding false negative results) in the same way as ordinary z-scores. From false*

Lab no.	Sample	Suspected coliform bacteria (MF)			Coliform bacteria (MF)			Susp. thermotolerant coliform bact. (MF)			*E. coli* (MF)			Coliform bacteria ("rapid" MPN)			*E. coli* ("rapid" MPN)		
	A B C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1131	1 2 3													-0.922	-0.210	1.007	-1.909	0.000	0.810
1132	3 1 2													0.898	-0.622	-0.742	2.163	0.000	-0.234
1237	2 1 3				1.418	0.025	-0.546				0.119	0.000	-0.033	-1.511	-0.282		-1.186	0.000	
1254	1 3 2				-0.626	-0.812	-1.085				-0.140	0.000	-1.331	0.123	0.821	-0.844	-0.858	0.000	-0.923
1290	3 1 2				0.453	4.000	0.064				0.368	0.000	-0.033						
1545	2 1 3				-0.821	-0.488	1.232				-0.698	0.000	-0.649	-2.643	-0.745	-0.102	-1.909	0.000	0.336
1594	1 2 3				-0.821	0.416	0.885				-0.412	0.000	0.643	0.597	0.901	-0.191	0.028	0.000	0.843
1611	1 3 2				-0.437	0.973	-0.140				-0.698	0.000	0.424	1.189	0.312	-0.765	0.808	0.000	-0.717
1753	1 3 2				-0.251	0.320	0.708				0.119	0.000	0.855	0.442	0.845	1.006	0.808	0.000	2.300
1868	1 3 2				0.621	0.763	0.526				1.490	0.000	1.935	0.284	2.204	-0.511	-0.549	0.000	1.384
1970	3 1 2				1.418	-0.812	0.708				2.088	0.000	0.750						
2050	2 3 1				0.621	1.585	1.729				0.368	0.000	1.842	-0.041	-0.112	-0.172	0.558	0.000	0.597
2386	1 2 3				0.282	0.320	0.617				0.119	0.000	0.643	-0.209	2.112	1.361	-0.858	0.000	1.313
2637	3 1 2													0.898	-0.282	0.581	1.051	0.000	0.205
2670	3 2 1				-4.000	-0.279	-2.184				-1.667	0.000	-0.793						
2704	3 1 2				-0.251		0.797				0.119	0.000	2.208	1.608	-0.529	0.331	0.028	0.000	0.466
2745	2 1 3				-1.875	1.585	0.247				-1.000	0.000	1.654						
3055	3 2 1																		
3057	3 2 1				2.577	-1.035	-0.974				3.168	0.000		-1.113	-2.818	-4.000	1.286		
3076	1 2 3																		
3145	2 3 1													1.189	0.845	0.222	0.808	0.000	0.268
3155	3 2 1																		
3162	2 3 1													-0.922	2.691	-0.742	-1.186	0.000	-0.234
3305	2 3 1				0.786	0.791	-1.428				0.839	0.000	-0.033	0.123	-0.103	0.074	0.028	0.000	0.466
3533	1 3 2																		
3587	3 1 2																		
3730	3 1 2																		
3883	3 1 2				-0.821	0.025	0.973				-0.412	0.000	0.199	1.331	0.210	1.863	1.051	0.000	3.286
4015	2 3 1													-0.209	4.000	0.288	-0.858	0.000	0.336
4288	3 1 2																		
4339	1 3 2				0.621	1.063	0.708				0.839	0.000	-1.331	1.331	-0.650	-0.014	0.808	0.000	-0.627
4343	3 1 2													0.442	1.419	1.569	0.298	0.000	1.684
4356	2 3 1				0.786	0.882	-0.341				1.894	0.000	-0.780	0.442	0.046	-1.606	0.298	0.000	-1.202
4459	3 2 1													1.877	-1.166			0.000	-1.200
4723	2 1 3													0.123	-0.455	1.283	-0.549	0.000	1.094
4817	2 3 1				-1.224	-2.128	-0.341												
4889	2 1 3				-0.251	-1.622	-0.443				-0.140	0.000	-0.521	-0.737	-1.547	-0.942	0.558	0.000	-1.232
5018	2 1 3				1.720	0.791	-2.515				1.490	0.000		-0.922	0.312	-0.067	-0.254	0.000	-1.200
5094	3 1 2				-0.626	-0.922	-3.151				-1.667	0.000	-2.634						
5220	3 1 2													-0.209	0.046		-0.254	0.000	
5352	3 1 2				-0.070	-0.594	0.617				0.608	0.000	-0.033						
5447	3 1 2				-0.070	0.416	0.055				0.119	0.000	-2.451						
5494	2 1 3					-4.000	-4.000												
5612	3 2 1				0.282	0.320					0.368	0.000		-0.737	-1.653	0.331	-0.254	0.000	0.466
5858	1 2 3													0.284	0.980	-1.203	0.298	0.000	-0.759
5950	3 2 1				0.786	0.846	-0.757				-0.412	0.000	-0.396	-0.737	0.570	-2.573	0.558	0.000	-1.202
6175	3 1 2													-0.209			-1.186	0.000	
6182	1 2 3																		
6233	2 1 3				-1.651	-0.383	0.247				-1.000	0.000	0.643	1.044	0.252	-0.742	1.736	0.000	-0.234
6253	1 3 2													-0.557	-1.653	1.667	-0.254	0.000	1.207
6448	3 2 1				0.948	0.605	-0.443				-0.412	0.000	-0.649						
6456	1 2 3				-0.070	0.125	0.526				-1.321	0.000	0.313	-1.720	1.290	0.824	-1.186	0.000	-0.774
6563	3 2 1				0.108	-3.103	1.060				0.839	0.000	1.461	0.284	0.176	1.139	0.028	0.000	0.685
6686	3 2 1													0.612	-0.557		0.808	0.000	
6801	2 1 3				-1.435	4.000	-4.000					0.000							
7191	2 3 1																		
7248	1 2 3				4.000	-1.745	1.809				-0.698	0.000	0.199	0.442	0.845	0.331	1.051	0.000	0.018
7282	1 2 3										0.839	0.000	-0.194						
7330	3 2 1										-0.698	0.000	-1.115						
7442	1 3 2				0.108	0.809	-0.015				0.119	0.000	-0.054	0.123	1.035	-1.519	1.051	0.000	-0.841
7564	3 2 1				1.720	0.416	-0.341				0.608	0.000	-0.780						
7688	2 1 3				-1.224	-0.812	-0.042				-2.042	0.000	-0.649	0.284	-0.455	-0.511	0.028	0.000	-0.908
7728	3 2 1				-0.251	0.320	-0.341				-1.667	0.000	0.199						
7876	2 3 1				-1.020	0.291	0.885				-1.321	0.000	0.424	1.044	-1.390	-0.083	0.808	0.000	-0.451
7930	1 3 2				-0.626	-0.176	-0.240				-0.412	0.000	0.084	0.284	-0.282	0.498	1.051	0.000	0.336
7962	3 1 2				0.453	0.223	0.617				1.063	0.000	1.062	-1.511	-0.210	0.220	-1.909	0.000	-1.200
7968	1 2 3				-0.437	0.882	-0.140				-0.140	0.000	-0.458	0.749	-0.372	-0.068	0.808	0.000	-0.926
8019	1 2 3				-0.626	0.223	-0.140				0.119	0.000	-0.396	0.284	0.668	0.108	0.028	0.000	0.517
8068	1 2 3				-1.875	-0.488	-0.865				-1.000	0.000	0.534	-1.511	-1.338	-1.142	-0.254	0.000	-0.923
8260	1 3 2				-0.437	0.425	-0.091				-0.140	0.000	-0.458						
8329	3 1 2				0.786	0.882	0.247				0.368	0.000	0.199	0.284	0.046	0.134	-1.186	0.000	-0.091
8380	2 1 3				-0.070	0.125	1.483				0.608	0.000	1.264	-0.209	0.329	-0.102	-0.549	0.000	0.336
8435	3 2 1				4.000	-1.870	-0.931				-0.140	0.000	-0.649						
8569	3 2 1				0.786	0.605	0.434				-1.000	0.000	-0.521	0.442	0.312	3.178	0.028	0.000	-1.200
8626	1 2 3				-0.821	-0.075					0.608								
8628	1 3 2				0.621	-1.035	-0.651				-0.412	0.000							
8663	3 1 2				2.157	0.511	0.973				1.279	0.000	-0.396	1.743	-1.136	0.498	1.736	0.000	-1.232
8696	1 3 2					4.000													
8742	1 3 2				-1.875	0.125	-0.341				-1.667	0.000	-1.331						
8766	3 1 2				0.621	-1.513	0.434				0.368	0.000	0.424	-0.557	0.312	0.739	-0.549	0.000	0.810
8862	2 1 3				0.108	0.425	0.341				-0.412	0.000	0.313	-1.113	1.136	-0.654	-0.254	0.000	-0.649
8891	1 3 2				-1.020	-1.934	-1.085												
8898	3 1 2				1.107	1.098	1.020				0.119	0.000	0.969	-0.557	0.278	-0.272	-0.549	0.000	0.535
8998	3 2 1																		

positive results can no z-scores be calculated. z-scores from outliers are not real z-scores but a practical means to express also the results from the outliers. Very low and high values are here limited to –4 and +4, respectively.

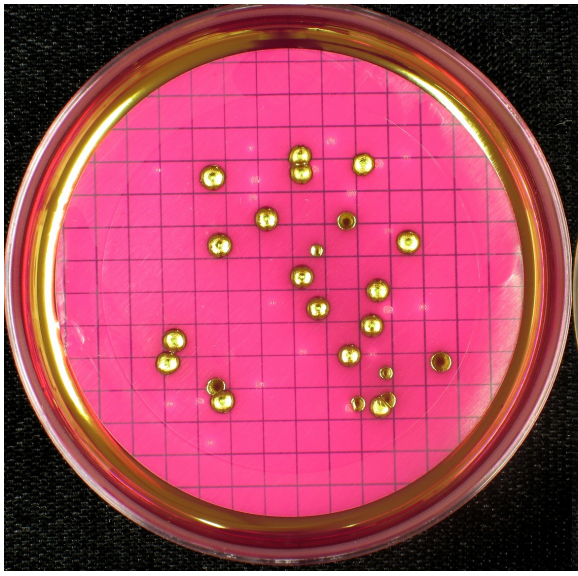
Susp. intestinal enterococci (MF)			Intestinal enterococci (MF)			Susp. *Pseudomonas aeruginosa* (MF)			*Pseudomonas aeruginosa* (MF)			Total plate count 22 °C, 3 days			Total plate count 36±2 °C, 2 days			Lab no.
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
												0.136	1.236	0.917				1131
			0.000	-0.060	-1.975							-0.135	0.276	0.098				1132
			0.000	-0.391	-4.000				-2.654		-2.173	0.792	-0.066	-1.749	1.043	0.307	-0.783	1237
			0.000	-0.646	-0.660				-0.010	0.000	-0.094	-0.273	0.606	-0.247	-0.705	0.403	-0.138	1254
				4.000	-0.107				0.933	0.000	-0.042	0.001	-0.066	0.995	-1.569	-4.000	0.841	1290
			0.000	-0.142	1.109				0.786	0.000	0.403	4.000	4.000	-0.160	4.000	4.000	1.309	1545
			0.000	0.577	-0.193				0.786	0.000	-0.228	0.001	-0.793	1.458	-0.241	0.111	0.602	1594
			0.000	0.046	0.539				-0.182	0.000	-0.394	-0.411	-2.974	0.182	-0.471	-0.715	-2.021	1611
			0.000	0.263	-1.247				-2.355	0.000	-1.383	0.001	0.276	-0.513	-0.355	-0.397	0.481	1753
												0.533	-1.181	0.182				1868
			0.000	0.808	0.256				-0.010	0.000	0.162	-0.980	-1.589	-1.548	-1.315	-1.745	-0.783	1970
				0.063	1.515				-0.735	0.000	1.461	0.269	0.276	-0.247	-0.587	0.209	1.765	2050
			0.000	-0.560	0.123				0.158	0.000	0.959	1.298	-0.066	-0.335	0.735	1.234	0.722	2386
												-0.551	4.000	-0.160	-1.315	-3.219	-2.312	2637
			0.000	1.109	-1.814				-1.356	0.000	-2.199	-4.000	-4.000	-2.058	-1.441	3.636	-0.265	2670
			0.000	-0.224	-1.867				-2.080	0.000	-3.252	-1.126	-0.793	-0.335	-1.190	0.307	-0.393	2704
												0.663	-0.066	-0.693				2745
												2.726	2.928	1.306				3055
			0.000	0.263	-0.613				-0.010	0.000	-0.282	1.173	-1.181	-0.785	-0.241	0.307	-1.596	3057
									-0.735	0.000	-0.228	1.173	-0.066	0.757	-0.241	0.499	-0.652	3076
																		3145
					-0.901				0.321						0.525	-0.089	-0.652	3155
			0.000	-0.907	-0.532				-0.544	0.000	0.744	0.402	0.276	0.757	-0.471	0.780	0.481	3162
				0.499	-0.660				0.321	0.000	0.284	0.792	-0.066	0.677	0.525	0.964	-0.138	3305
												-0.551	-0.422	-2.270				3533
																		3587
												-1.423	-0.793	0.596				3730
			0.000	0.577	0.647				0.933	0.000	0.162	-1.126	-0.066	0.182	1.244	-2.512	0.236	3883
			0.000	0.476	-0.102							-0.273	1.536	2.337				4015
												-3.724	4.000	-1.450				4288
			0.000	-1.824	0.256				0.786	0.000	0.744	0.533	0.276	0.182	0.631	0.403	1.077	4339
				0.569	-0.703				-0.933	0.000	-1.309	-1.274	0.606	0.677	-1.066	-0.397	-0.265	4343
			0.000	-0.060	-0.756				0.634	0.000	1.266	-0.135	-0.793	-0.423	0.419	0.011	0.841	4356
												-0.551	-0.422	-0.335	-0.017	-0.191	0.602	4459
			0.000	-0.158	-1.147							-4.000	4.000	-0.073				4723
									0.321	0.000	0.162	-0.836	-0.793	-0.073	-0.471	1.145	-0.393	4817
			0.000	0.022	4.000				0.480	0.000		-0.551	-1.589	-0.335	-0.471	0.011	0.236	4889
			0.000	-1.264	-0.565				1.078	0.000	0.633	-0.411	-1.181	0.349	0.839	-0.824	0.359	5018
			0.000	-0.224	-0.999							-0.273	2.391	-0.160	0.094	1.839	0.359	5094
									-4.000	0.000								5220
			0.000	-0.819	4.000				2.384	0.000	0.036	0.001	-0.066	0.837	0.525	1.055	-0.783	5352
			0.000	0.499	-0.660				1.219	0.000	0.633	-0.135	1.536	-0.335	0.419	-0.608	0.236	5447
												3.177		1.152	2.925	-0.934	0.959	5494
			0.000	0.499	0.518				-0.735	0.000	-0.813	0.136	1.536	-0.785	-0.355	-0.293	-1.596	5612
				2.454	0.561				-0.182	0.000	-0.269	1.666	0.276	2.266	1.637	1.055	-0.916	5858
			0.000	-0.776	-0.276				-0.182	0.000	0.959	-2.518	4.000	-0.073	-0.587	-4.000	0.602	5950
												-0.135	-0.422	-0.160	-0.705	0.403	-0.265	6175
																		6182
			0.000	0.731	0.011				-0.544	0.000	1.063	1.173	-0.066	-1.352	-0.705	0.111	-1.737	6233
			0.000	-0.475	0.256							0.920	0.276	0.182				6253
									-0.010	0.000	2.353				-0.017	0.111	0.112	6448
												0.402	1.236	0.013	0.631	0.780	-1.458	6456
			0.000	-0.019	-1.932				0.321	0.000	-0.613	-2.850	0.276	-1.255	-1.190	-0.824	0.236	6563
												-0.836	-0.066	0.837	2.112	1.497	0.722	6686
									-3.360	0.000	-1.129					0.209	4.000	6801
																		7191
												-0.273	-1.589	0.757				7248
			0.000	-0.158	0.539				0.321	0.000	0.633				2.297	0.403	-0.393	7282
			0.000	-0.349	-0.999				-0.010	0.000	0.403				-0.824	-1.992	-1.320	7330
												-0.135	-0.422	-0.513				7442
												0.136	0.276	-0.785	0.735	0.593	-0.013	7564
				-0.391	0.689				-0.933	0.000	-0.466	-0.836	-0.066	-0.693	1.829	0.964	-1.049	7688
			0.000	-1.448	0.256				-0.544	0.000	-0.658	-1.274	0.276	-0.877	-1.699	-0.934	0.112	7728
			0.000	0.319	1.109				-0.182	0.000	1.053	0.792	-0.422	0.182	-0.471	-0.089	0.236	7876
			0.000	0.421	-0.193				0.321	0.000	1.266	0.136	-0.066	0.837	0.525	-0.191	1.193	7930
				1.109	0.033					0.000		-0.411	-2.480	-0.513	-0.944	1.754	-0.138	7962
			0.000	0.022	0.689				0.786	0.000	0.284	0.269	-0.793	-0.513	1.244	0.403	-1.049	7968
			0.000	0.577	-4.000				-0.010	0.000	0.074	-1.881	1.536	-0.160	-0.241	-1.045	0.722	8019
			0.000	-0.224	0.689				1.358	0.000	0.162	0.402	-0.066	-0.423	1.244	-0.715	2.534	8068
												0.402	0.606	0.596				8260
			0.000	1.939	0.518				-0.360	0.000	-1.309	1.421	-0.793	0.349	-0.129	0.964	1.424	8329
			0.000	-0.142	-0.660				1.888	0.000	0.633	-0.273	0.926	0.266	0.419	-1.045	1.193	8380
			0.000	-2.116	-1.147				-1.583	0.000		-0.551	-0.422	-0.513	0.735	0.873	-1.458	8435
			0.000	-0.732	-0.332							0.269	0.926	1.152				8569
												-1.126	-1.181	-2.377	-1.441	-2.247	-1.320	8626
				3.306	0.689				0.158	0.000	0.036	0.920	-0.422	-0.693	-1.699	-0.089	1.193	8628
			0.000	-0.224	1.109				1.219	0.000	0.633	1.788	0.606	3.296	-0.471	1.055	1.765	8663
				4.000									4.000			4.000		8696
												-0.135	1.236	-0.247	0.941	0.011	0.602	8742
			0.000	-0.689	-0.003				0.634	0.000	-0.976	-1.126	-0.066	-0.603	-0.705	1.055	-0.265	8766
			0.000	1.720	0.728							0.402	0.606	0.596				8862
												0.402	0.276	0.098				8891
			0.000	-0.646	-0.125				1.219	0.000	-0.187	-0.273	0.606	0.917	0.203	0.209	-0.916	8898
																		8998

Lab no.	Sample			Suspected coliform bacteria (MF)			Coliform bacteria (MF)			Susp. thermotolerant coliform bact. (MF)			*E. coli* (MF)			Coliform bacteria ("rapid" MPN)			*E. coli* ("rapid" MPN)		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
9002	3	1	2				**4.000**	1.837	-1.914				-1.000	0.000	-1.478						
9051	2	1	3				0.453	0.800	-0.546				1.063	0.000	-1.189	0.749	-0.237	-0.757	-0.549	0.000	-0.704
9306	1	3	2													0.442	0.586	0.706	-0.549	0.000	1.201
9408	1	3	2													-0.557	-0.880	-0.742	-0.858	0.000	-0.469
9436	2	3	1				-0.821	0.164	-0.042				-0.412	0.000	-0.152	**-2.162**	-0.427	-1.797	-1.909	0.000	-1.210
9441	1	3	2													1.608	-1.036	-0.373	**2.369**	0.000	-1.076
9524	1	3	2				-1.020	0.320	-0.443				-0.412	0.000	-0.033	-1.511	-0.641	0.030	-0.858	0.000	0.644
9736	2	3	1													-1.113	0.570	-0.012	-0.549	0.000	0.510
9899	1	2	3				0.621	0.735	1.400				1.063	0.000	1.164	0.597	-0.363	-0.742	0.808	0.000	-0.234
9903	3	2	1				0.453	-1.241	1.177				0.368	0.000	1.113						
n				0	0	0	62	63	61	0	0	0	61	61	56	60	59	55	59	59	55
Min							-4.000	-4.000	-4.000				-2.042	0.000	-2.634	-2.643	-2.818	-4.000	-1.909	0.000	-1.232
Max							4.000	4.000	1.809				3.168	0.000	2.208	1.877	4.000	3.178	2.369	0.000	3.286
Median							0.019	0.320	-0.042				0.119	0.000	-0.033	0.204	0.046	-0.067	0.028	0.000	-0.091
Mean							0.129	0.127	-0.131				0.000	0.000	0.000	0.000	0.068	-0.073	0.000	0.000	0.000
SD							1.402	1.397	1.218				1.000	0.000	1.000	1.000	1.120	1.128	1.000	0.000	1.000
z<-3							1	2	3				0	0	0	0	0	1	0	0	0
-3≤z<-2							0	1	2				1	0	2	2	1	1	0	0	0
2<z≤3							2	0	0				1	0	1	0	3	0	2	0	1
z>3							3	3	0				1	0	0	0	1	1	0	0	1

Susp. intestinal enterococci (MF)			Intestinal enterococci (MF)			Susp. *Pseudomonas aeruginosa* (MF)			*Pseudomonas aeruginosa* (MF)			Total plate count 22 °C, 3 days			Total plate count 36±2 °C, 2 days			Lab no.
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
			0.000	**-2.417**								-1.726	0.276	-1.255				**9002**
			0.000	0.499	**2.667**				-1.824	0.000	-1.009	0.663	-0.066	-0.603	1.144	0.111	-0.138	**9051**
												0.402	1.236	0.757	0.419	-0.293	0.112	**9306**
			0.000	-1.448	1.109				-0.544	0.000	-0.228	-0.411	1.236	1.832	0.203	-0.502	-1.878	**9408**
			0.000	-0.084	1.109				-0.182	0.000	0.711	-0.135	-1.181	-1.159	0.525	-1.745	0.841	**9436**
												0.402	0.276	0.995	-0.129	**-4.000**	0.722	**9441**
			0.000	-1.328	1.714							-0.411	-0.793	-0.693	-0.355	0.307	-0.265	**9524**
			0.000	0.499	-0.490				-0.544	0.000	0.296	1.298	0.276	-0.785	-1.441	-0.191	0.602	**9736**
				0.046	-0.258				-0.182	0.000	0.124	0.001	-1.181	0.514	-0.587	0.593	0.841	**9899**
			0.000	1.027	**2.481**				0.786	0.000	0.906	0.269	0.606	1.229	0.094	0.780	0.481	**9903**
0	0	0	51	61	60	0	0	0	56	55	52	82	82	82	68	70	69	**n**
			0.000	-2.417	-4.000				-4.000	0.000	-3.252	-4.000	-4.000	-2.377	-1.699	-4.000	-2.312	**Min**
			0.000	4.000	4.000				2.384	0.000	2.353	4.000	4.000	3.296	4.000	4.000	4.000	**Max**
			0.000	-0.019	-0.052				-0.010	0.000	0.143	-0.067	-0.066	-0.117	-0.129	0.111	0.112	**Median**
			0.000	0.131	0.000				-0.131	0.000	0.000	-0.094	0.244	0.000	0.059	-0.005	0.058	**Mean**
			0.000	1.218	1.420				1.201	0.000	1.000	1.306	1.495	1.000	1.105	1.505	1.103	**SD**
																		Summa
			0	0	2				2	0	1	3	1	0	0	4	0	20
			0	2	0				3	0	2	2	2	3	0	2	2	28
			0	1	2				1	0	1	1	2	2	3	0	1	24
			0	3	2				0	0	0	2	6	1	1	3	1	29

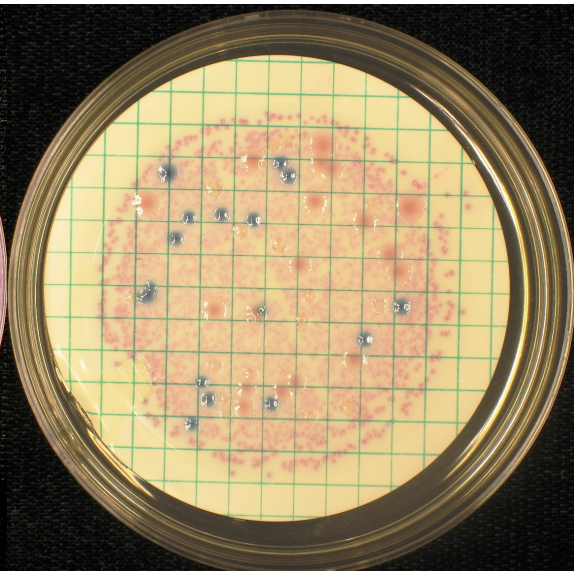
Mixture A

m-Endo Agar LES, 37 °C



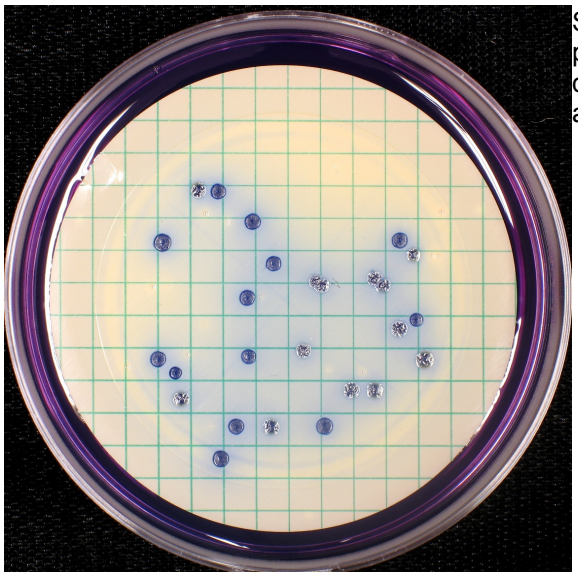
100 ml

Chromocult Coliform Agar, 37 °C



100 ml

m-FC Agar, 44 °C



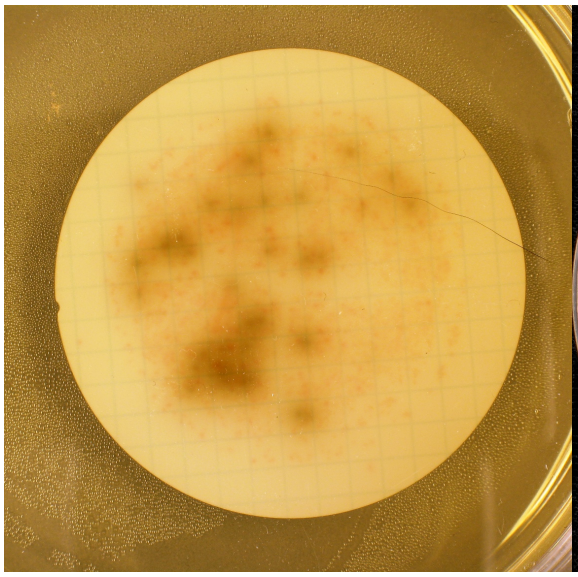
100 ml

Something went wrong with the extra plate for photographing. Almost nothing appeard after 2 days of incubation. If possible a photo will be added later.

m-Enterococcus Agar, 37 °C

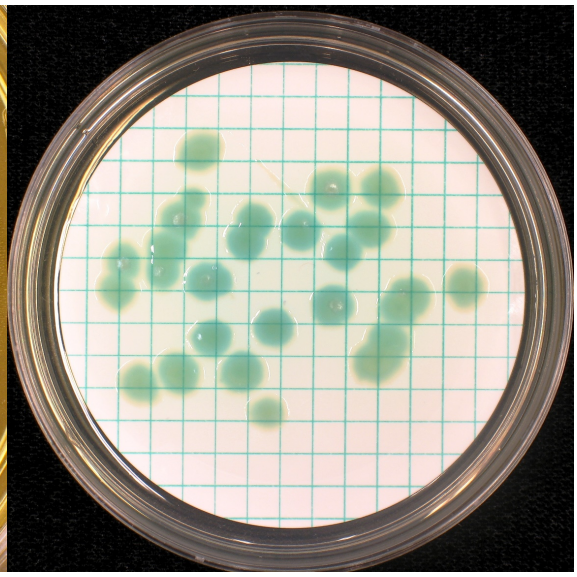
1 ml, 2 days

Bile Esculin Azide Agar, 44 °C



2 hours (from beneath)

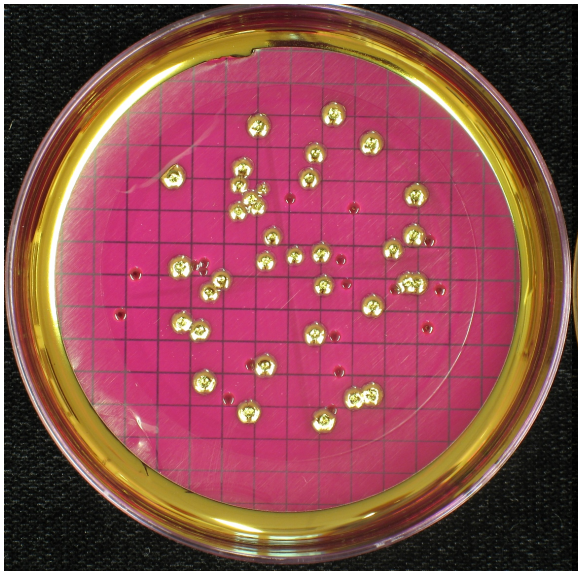
m-Pseudomonas CN Agar, 37 °C



100 ml, 2 days

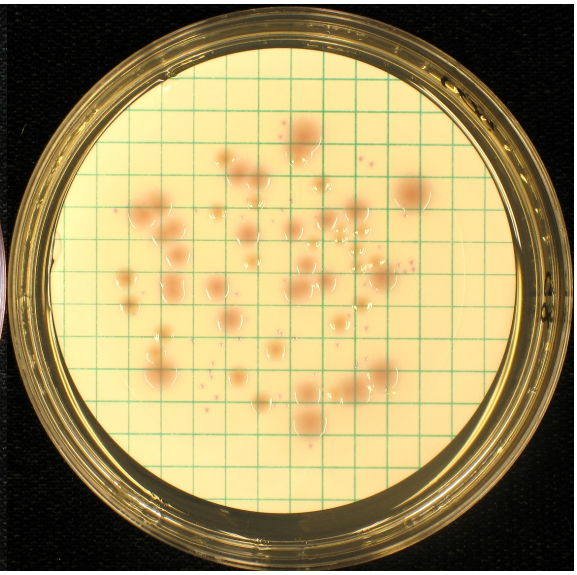
Mixture B

m-Endo Agar LES, 37 °C



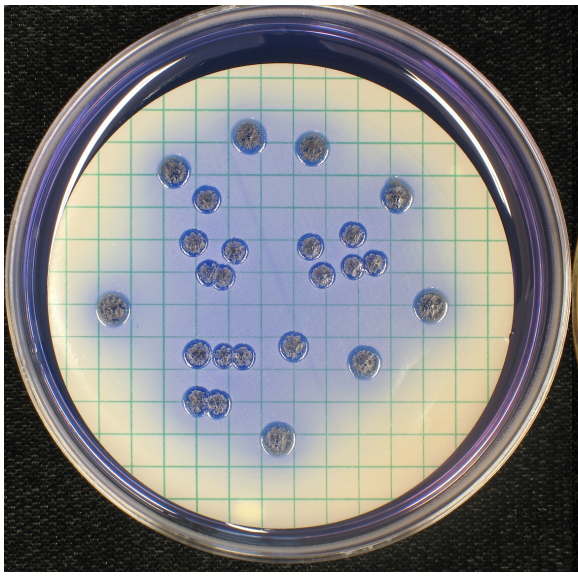
10 ml

Chromocult Coliform Agar, 37 °C



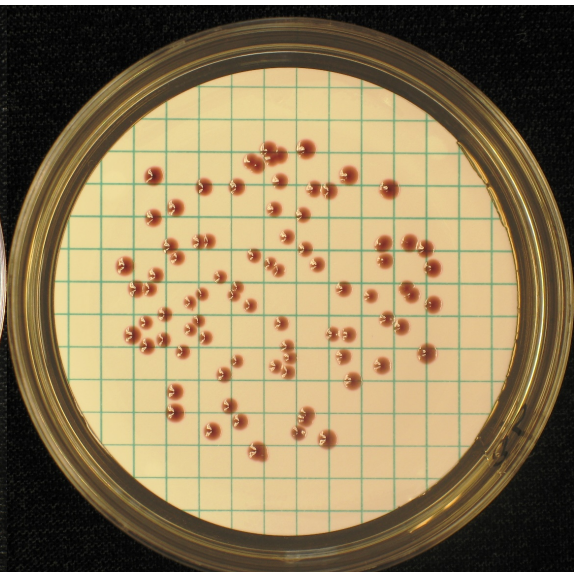
10 ml

m-FC Agar, 44 °C



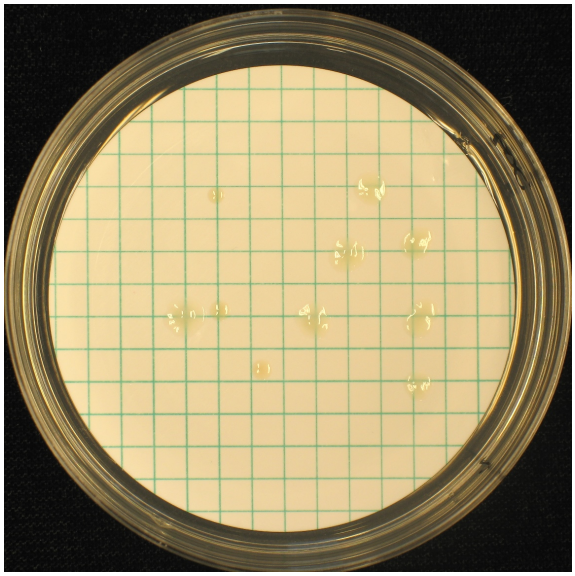
10 ml

m-Enterococcus Agar, 37 °C



10 ml, 2 days

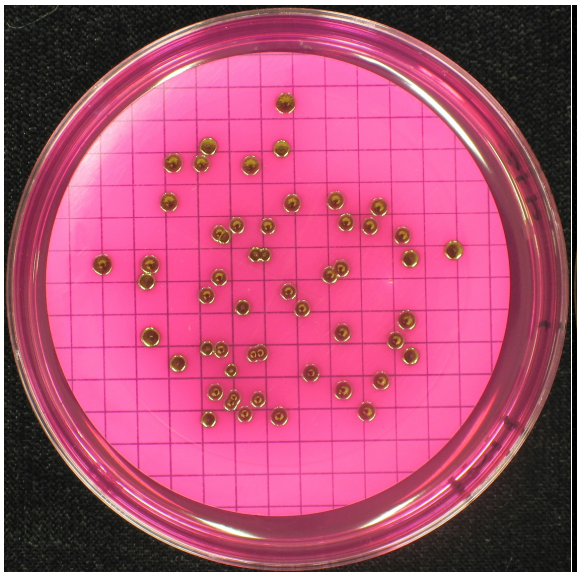
m-Pseudomonas CN Agar, 37 °C



100 ml, 2 days

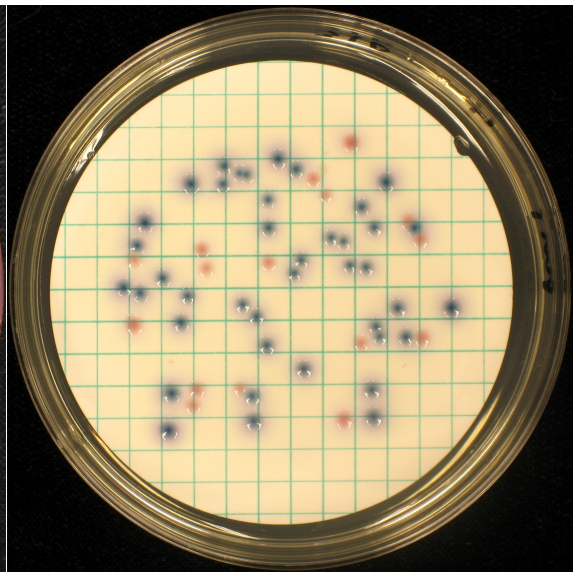
Mixture C

m-Endo Agar LES, 37 °C



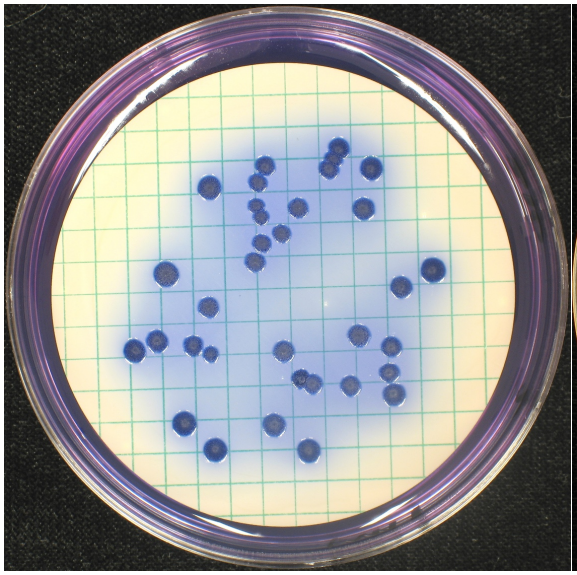
1 ml

m-Lactose TTC Agar, 37 °C



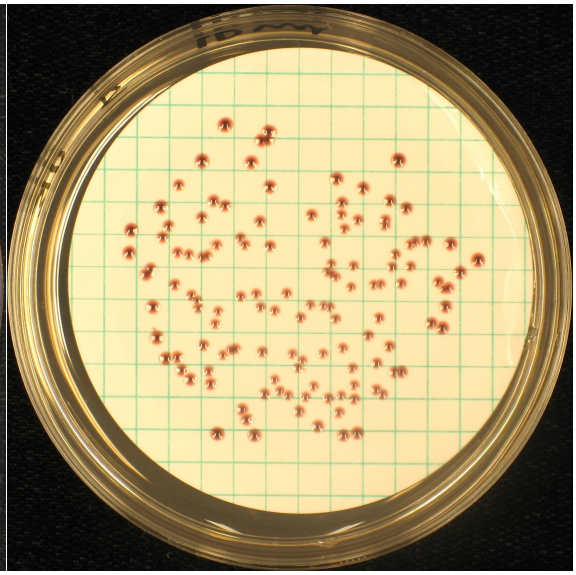
1 ml

m-FC Agar, 44 °C



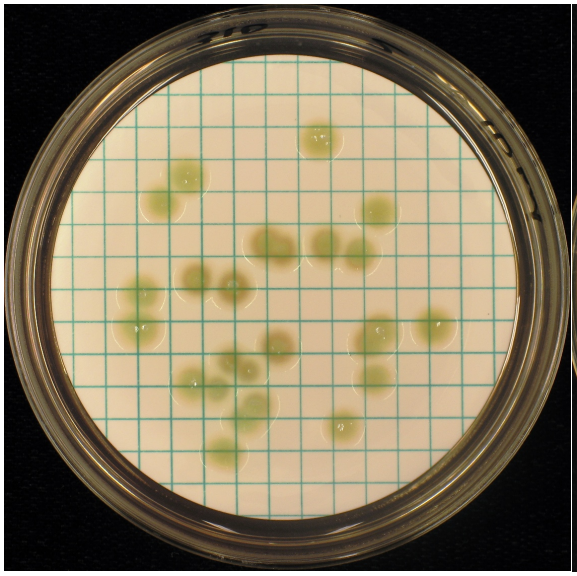
1 ml

Chromocult Coliform Agar, 37 °C



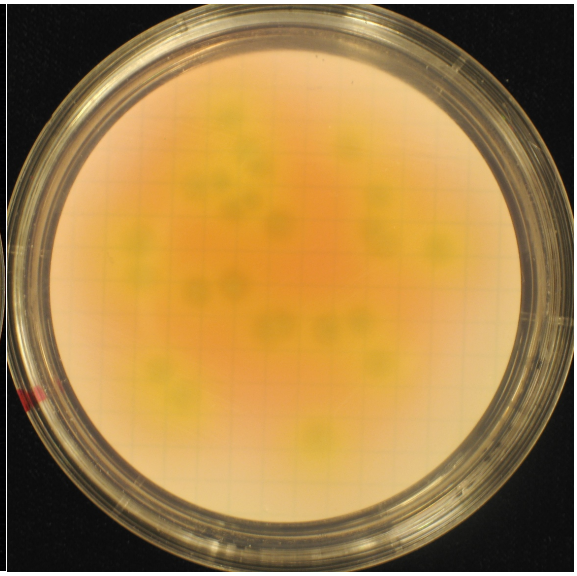
10 ml

m-Enterococcus Agar, 37 °C



10 ml, 2 days

m-Pseudomonas CN Agar, 37 °C



10 ml, 2 days from beneath)

PT reports published 2017

Proficiency Testing – Food Microbiology, January 2017, by Jonas Ilbäck

Proficiency Testing – Drinking Water Microbiology, March 2017, by Tommy Šlapokas

Proficiency Testing – Food Microbiology, April 2017, by Jonas Ilbäck

Proficiency Testing – Drinking Water Microbiology, September 2017, by Tommy Šlapokas

Proficiency Testing – Food Microbiology, October 2017, by Jonas Ilbäck

PT reports published 2018

Proficiency Testing – Food Microbiology, January 2018, by Jonas Ilbäck

Proficiency Testing – Drinking Water Microbiology, March 2018, by Tommy Šlapokas

Proficiency Testing – Food Microbiology, April 2018, by Jonas Ilbäck

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 laboratories report their results to the organiser that evaluates them 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: https://www2.slv.se/absint

The National Food Agency's reference material

As a complement to the proficiency testing but without specific accreditation, National Food Agency also produces 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: https://www.livsmedelsverket.se/en/RM-micro