

Interim Summary Report

on the 22nd EURL-*Salmonella* interlaboratory comparison study (2017) on typing of *Salmonella* spp.

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1. Introduction

This interim summary report describes the overall results on the serotyping part of the 22nd interlaboratory comparison study on typing of *Salmonella* spp. organised by the European Union Reference Laboratory for *Salmonella* (EURL-*Salmonella*, Bilthoven, the Netherlands). Results of the study on PFGE typing will be reported separately.

A total of 35 laboratories participated in this study. These included 29 National Reference Laboratories for *Salmonella* (NRLs-*Salmonella*) in the 28 EU Member States, 2 NRLs of EU-candidate countries, 3 NRLs of EFTA countries, and 1 non-European NRL. The main objective of this study was to check the performance of the NRLs for typing of *Salmonella* spp. and to compare the results of typing of *Salmonella* spp. among the NRLs-*Salmonella*. All NRLs performed serotyping of the strains. NRLs of the EU member states which do not achieve the level of good performance for serotyping have to participate in a follow-up study.

2. Materials and Methods

2.1. *Salmonella* strains for serotyping

A total number of 20 *Salmonella* strains (coded S1 - S20) had to be serotyped by the participants. As discussed at the 22nd EURL-*Salmonella* Workshop in Zaandam, NL (EURL-*Salmonella*, 2017), one additional strain (S21), being a less common strain, was included in the study and serotyping of this strain was optional.

The *Salmonella* strains used for the study on serotyping originated from the collection of the National *Salmonella* Centre in the Netherlands. The strains were typed once again by this Centre before mailing. The complete antigenic formulas, according to the most recent White-Kauffmann-Le Minor scheme (Grimont and Weill, 2007), of the 21 serovars are shown in Table 1. However, participants were asked to report only those results, on which the identification of serovar names was based.

2.2 Laboratory codes

The NRLs-*Salmonella* were assigned a random laboratory code 1-35, which differed from the previous typing studies.

Table 1. Antigenic formulas of the 21 *Salmonella* strains according to the White-Kauffmann-LeMinor scheme used in the 22nd EURL- *Salmonella* typing study

Strain code	O-antigens	H-antigens (phase 1)	H-antigens (phase 2)	Serovar
S1	<u>1</u> ,4,[5],12	f,g,s	[1,2]	Agona
S2	6,8	Z ₁₀	e,n,x	Hadar
S3	3,{10},{ <u>15</u> }	r	Z ₆	Weltevreden
S4	28	i	1,5	Cotham
S5	<u>1</u> ,9,12	a	e,n,Z ₁₅	Durban
S6	4,12	e,h	1,7	Kaapstad
S7	<u>1</u> ,4,[5],12	i	1,2	Typhimurium
S8	<u>1</u> ,9,12	l,Z ₁₃	e,n,x	Napoli
S9	<u>1</u> ,13,22	z	1,6	Poona
S10	6,7, <u>14</u>	r	1,2	Virchow
S11	<u>1</u> ,13,23	y	l,w	Ordonez
S12	8,20	r,[i]	Z ₆	Altona
S13	6,7, <u>14</u>	Z ₁₀	l,w	Jerusalem
S14	6,7, <u>14</u>	r	1,5	Infantis
S15	<u>1</u> ,4,[5],12,[27]	d	1,2	Stanley
S16	<u>1</u> ,4,[5],12,[27]	b	e,n,x	Abony
S17	<u>1</u> ,9,12	g,m	-	Enteritidis
S18	11	r	e,n,x	Rubislaw
S19 ^{a)}	<u>1</u> ,4,[5],12	i	-	1,4,[5],12:i:-
S20	6,7, <u>14</u>	Z ₁₀	e,n,Z ₁₅	Mbandaka
S21	50	k	z	50:k:z (IIIb)

^{a)} Typhimurium, monophasic variant as determined by PCR.

2.3 Transport

All samples were packed and transported as Biological Substance Category B (UN 3373) and transported by door-to-door courier service. The parcels containing the strains for typing were sent by the EURL-*Salmonella* on 30 October 2017.

2.4 Evaluation of the serotyping results

The evaluation of the serotyping results as mentioned in this report is described in Table 2.

Table 2. Evaluation of serotyping results

Results	Evaluation
Auto-agglutination or Incomplete set of antisera (outside range of antisera)	Not typable
Partly typable due to incomplete set of antisera or Part of the formula (for the name of the serovar) or No name serovar	Partly correct
Wrong serovar or mixed sera formula	Incorrect

In 2007, criteria for 'good performance' have been defined (Mooijman, 2007). Penalty points are given for strains that are typed incorrectly. A distinction is made between the five most important human health related *Salmonella* serovars (as indicated in EU legislation) and all other strains:

- **4 penalty points:** Incorrect typing of *S. Enteritidis*, *S. Typhimurium* (including the monophasic variant), *S. Hadar*, *S. Infantis* or *S. Virchow* or assigning the name of one of these 5 serotypes to another strain.
- **1 penalty point:** Incorrect typing of all other *Salmonella* serovars.

For each NRL-*Salmonella* the total number of penalty points is determined. The NRL meets the criterion of 'good performance' if it has less than 4 penalty points.

A follow-up study will be organised for NRLs with 4 penalty points or more. All NRLs of the EU Member states not meeting the criterion of 'good performance' are obliged to participate in this follow-up study.

3. Results

3.1 Serotyping results of the NRLs-*Salmonella*

3.1.1. General comments on this year's evaluation

As decided at the 22nd EURL-*Salmonella* Workshop, Strain S21 was an additional strain to the study. Testing of this strain was optional and results were not included in the evaluation.

3.1.2. Serotyping results per laboratory

The evaluation of the detection of O- and H-antigens and identification of the strains per laboratory are shown in Figures 1, 2 and 3 and the percentages of correct results in Figure 4.

The O-antigens were typed correctly by 31 of the 35 participants (89%). This corresponds to 99% of the total number of strains. The H-antigens were typed correctly by 28 of the 35 participants (80%), corresponding to 98% of the total number of strains. As a result, also 28 participants (80%) gave the correct serovar names, corresponding to 80% of all strains evaluated.

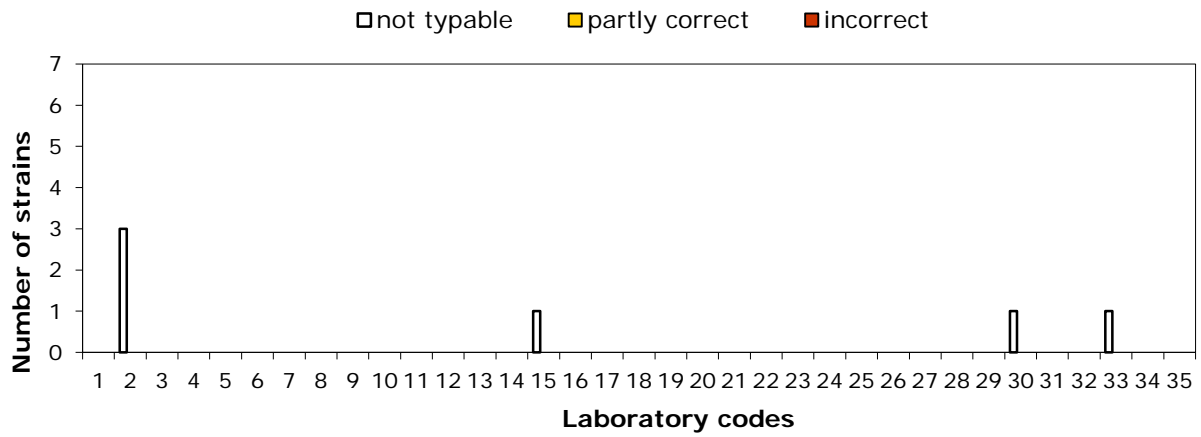


Figure 1. Evaluation of serotyping of O-antigens per NRL

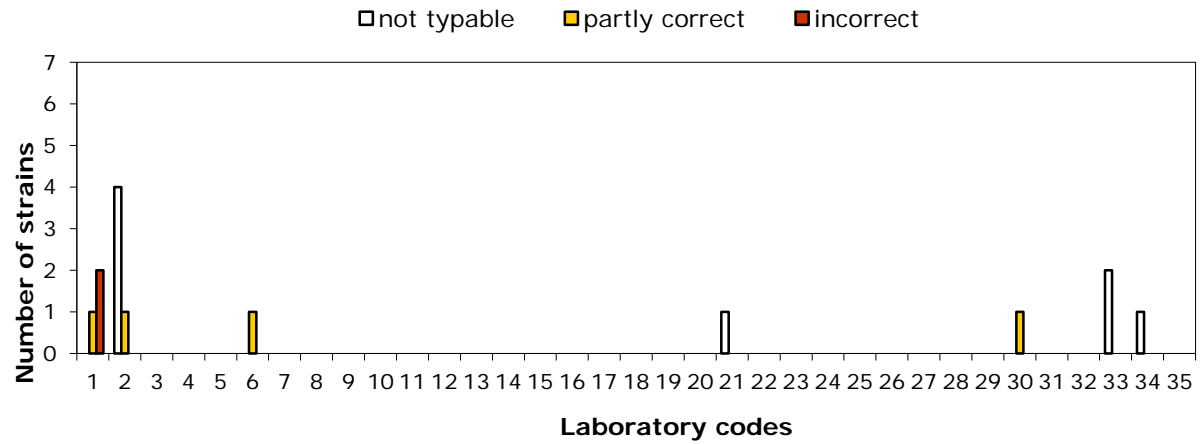


Figure 2. Evaluation of serotyping of H-antigens per NRL

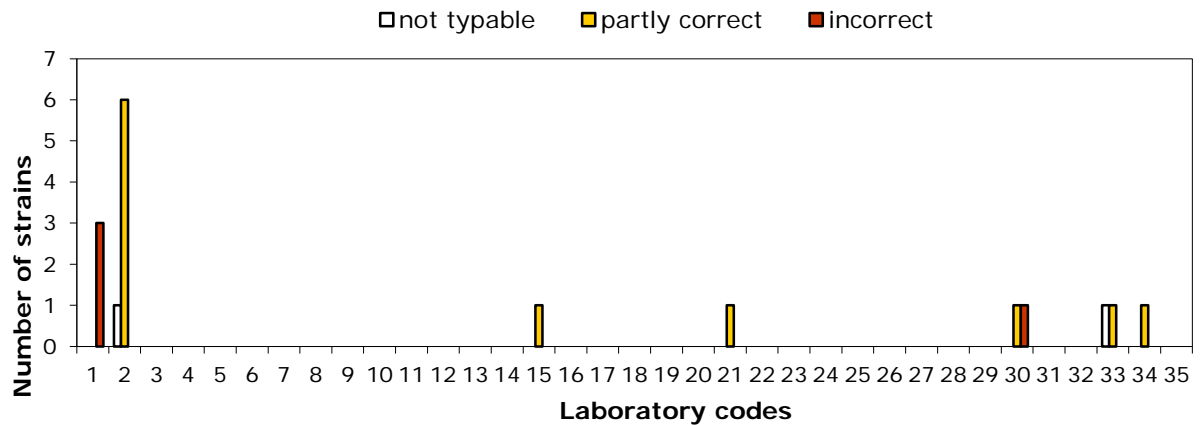


Figure 3. Evaluation of the correct serovar names per NRL

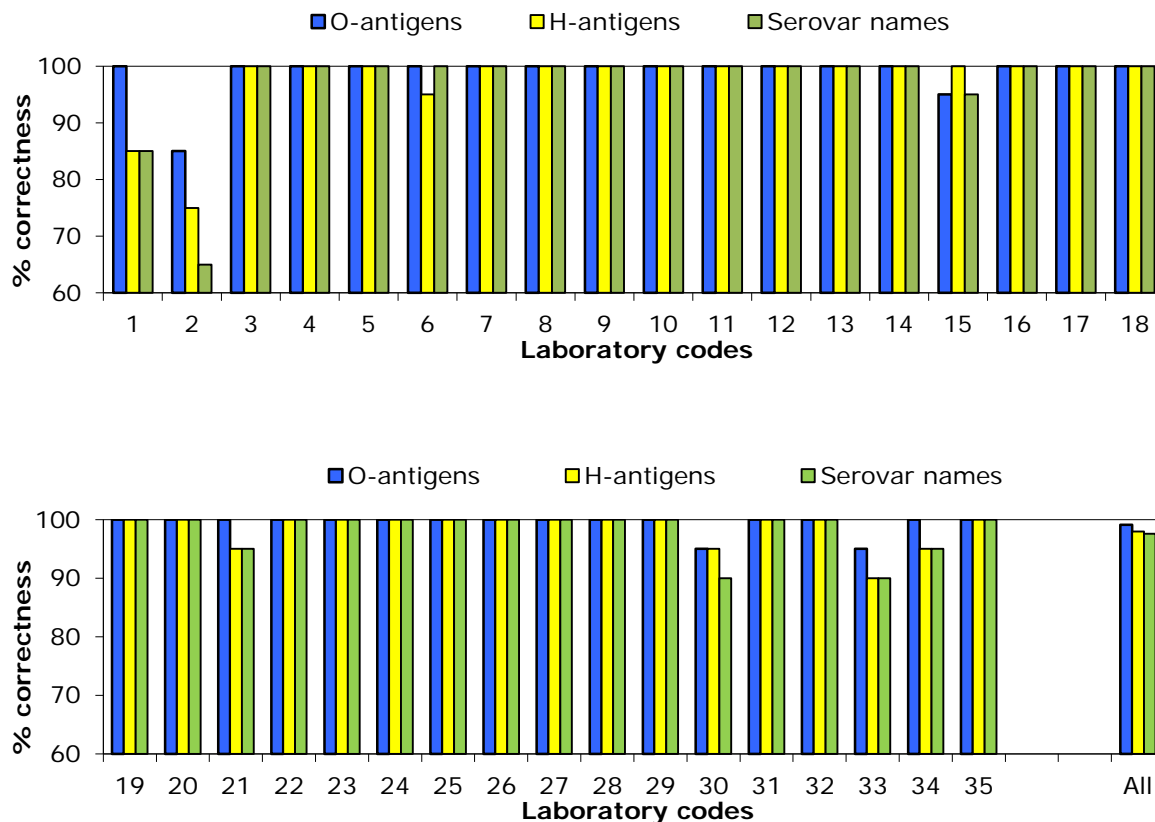


Figure 4. Achievements of the serotyping in percentages that were correct

For each NRL the number of penalty points was determined using the guidelines in section 2.4. Table 3 shows the number of penalty points for each NRL, the next column reports whether the level of good performance was achieved or not. All participants did meet the level of good performance at the first stage of the study and a follow-up study is not needed.

Table 3. Evaluation of serotyping results per NRL

Lab code	Penalty points	Good performance	Lab code	Penalty points	Good performance
1	3	yes	19	0	yes
2	0	yes	20	0	yes
3	0	yes	21	0	yes
4	0	yes	22	0	yes
5	0	yes	23	0	yes
6	0	yes	24	0	yes
7	0	yes	25	0	yes
8	0	yes	26	0	yes
9	0	yes	27	0	yes
10	0	yes	28	0	yes
11	0	yes	29	0	yes
12	0	yes	30	1	yes
13	0	yes	31	0	yes
14	0	yes	32	0	yes
15	0	yes	33	0	yes
16	0	yes	34	0	yes
17	0	yes	35	0	yes
18	0	yes			

3.1.3. Serotyping results per strain

Overall results found per strain and per laboratory are given in Annex A, except for the more complicated strains S19 and S21, which are separately reported in Annex B.

Apart from some spelling errors in the writing, a completely correct identification was obtained for ten *Salmonella* serovars: Hadar (S2), Durban (S5), Kaapstad (S6), Typhimurium (S7), Virchow (S10), Jerusalem (S13), Infantis (S14), Abony (S16), Enteritidis (S17), and 1,4,[5],12:i:- (S19).

Most problems were seen in strains that were showing a non-typable or only a partly typable result, e.g. due to being 'rough' or due to a lack of antisera required. Details on the strains that caused problems in serotyping are shown in Annex C. Only four strains were incorrectly identified.

The reported serovar names for strain 1,4,[5],12:i:- (S19) are shown in Annex B. Seventeen participants used a PCR method to confirm this strain to be a monophasic Typhimurium strain.

Details on the additional and optional strain S21 are given in Annex B as well. All but four participants actually tried to serotype this strain S21, being a *Salmonella enterica* subsp. *diarizonae* (IIb).

However, not all laboratories did have access to the required antisera to finalise this (50:k:z).

References

Grimont, P.A.D. and Weill, F-X., 2007. Antigenic formulae of the *Salmonella* serovars, 9th ed. WHO Collaborating Centre for Reference and Research on *Salmonella*. Institute Pasteur, Paris, France. https://www.pasteur.fr/sites/default/files/veng_0.pdf (accessed 12/2/2018).

Mooijman K.A., 2007. The twelfth EURL-*Salmonella* workshop; 7 and 8 May 2007, Bilthoven, the Netherlands. National Institute for Public Health and the Environment, Bilthoven, the Netherlands. Report no.: 330604006 (http://www.eurlsalmonella.eu/Publications/Workshop_Reports).

EURL-*Salmonella* 2017. The 22nd EURL-*Salmonella* workshop; 29-30 May 2017, Zaandam, The Netherlands. http://www.eurlsalmonella.eu/Workshops/Workshop_2017

List of abbreviations

EFTA	European Free Trade Association
EU	European Union
EURL- <i>Salmonella</i>	European Union Reference Laboratory for <i>Salmonella</i>
NRLs- <i>Salmonella</i>	National Reference Laboratories for <i>Salmonella</i>
REF	Reference
RIVM	National Institute for Public Health and the Environment

Annex A. Serotyping results per strain and laboratory

Lab:	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
REF	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
1	Derby	Hadar	Ughelli	Cotham	Burban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
2	Agona	Hadar	3,10:r:-	-:i:1,5	Durban	Kaapstad	Typhimurium	9:l,v:e,n,x	-:-:-	Virchow
3	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
4	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
5	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
6	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
7	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
8	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
9	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
10	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
11	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
12	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
13	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
14	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
15	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
16	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
17	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
18	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
19	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
20	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
21	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	1,9,12:-:e,n,x	Poona	Virchow
22	S. Agona	S. Hadar	S. Weltevreden	S. Cotham	S. Durban	S. Kaapstad	S. Typhimurium	S. Napoli	S. Poona	S. Virchow
23	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
24	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
25	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
26	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
27	S. Agona	S. Hadar	S. Weltevreden	S. Cotham	S. Durban	S. Kaapstad	S. Typhimurium	S. Napoli	S. Poona	S. Virchow
28	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
29	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
30	Agona	Hadar	Weltevreden		Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
31	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
32	S. Agona	S. Hadar	S. Weltevreden	S. Cotham	S. Durban	S. Kaapstad	S. Typhimurium	S. Napoli	S. Poona	S. Virchow
33	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
34	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
35	Agona	Hadar	Weltevreden	Cotham	Durban	Kaapstad	Typhimurium	Napoli	Poona	Virchow
X	1	0	1	0	0	0	0	0	0	0

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S11	S12	S13	S14	S15	S16	S17	S18	S20	Lab:
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	REF
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Escanaba	1
- : y : l,w	8 : r : -	Jerusalem	Infantis	Stanley	Abony	Enteritidis	11 : - : -	Mbandaka	2
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	3
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	4
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	5
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	6
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	7
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	8
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	9
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	10
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	11
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	12
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	13
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	14
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	'o' rough: r: e, n, x	Mbandaka	15
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	16
Ordonez	Altona	Jeruzalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	17
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	18
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	19
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	20
Ordonez	Altona	Jarusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	21
S. Ordonez	S. Altona	S. Jerusalem	S. Infantis	S. Stanley	S. Abony	S. Enteritidis	S. Rubislaw	S. Mbandaka	22
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	23
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	24
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	25
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	26
S. Ordonez	S. Altona	S. Jerusalem	S. Infantis	S. Stanley	S. Abony	S. Enteritidis	S. Rubislaw	S. Mbandaka	27
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	28
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	29
Ordonez	Altona	Jerusalem	Infantis	Eppendorf	Abony	Enteritidis	Rubislaw	Mbandaka	30
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	31
S. Ordonez	S. Altona	S. Jerusalem	S. Infantis	S. Stanley	S. Abony	S. Enteritidis	S. Rubislaw	S. Mbandaka	32
23: - : w	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw		33
13, 23: - : l,w	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	34
Ordonez	Altona	Jerusalem	Infantis	Stanley	Abony	Enteritidis	Rubislaw	Mbandaka	35
0	0	0	0	1	0	0	0	1	X

- remark (eg spelling error)
- not typable (eg antisera not available, rough)
- partly correct, in the naming: no penalty points
- incorrect, in the naming: 1 penalty point
- incorrect, in the naming: 4 penalty points

X = number of deviating laboratories (by penalty points) per strain

Results for Strains S19 and S21 are given in Annex B






Annex B. Details on serotyping results strains S19 and S21

Strain code	O-antigens	H-antigens (phase 1)	H-antigens (phase 2)	Serovar	PCR-confirmed	Lab code
S-1	1,4,[5],12	i	-	1,4,[5],12:i:-	yes	REF
S-1	4,5,12	i	-	4,5,12:i:-	no	1
S-1	4,5	i	-	4,5:i:-	yes	2
S-1	4,5,12	i	-	4,5,12:i:-	no	3
S-1	4	i	-	Typhimurium monophasic variant	yes	4
S-1	4,5,12	i	-	4,5,12:i:-	no	5
S-1	4,5,12	i	-	4,5,12:i:-	no	6
S-1	4,5	i	-	4,5,12:i:-	no	7
S-1	4,5,12	i	-	4,5,12:i:-	no	8
S-1	1,4,5,12	i	-	1,4,5,12:i:-	yes	9
S-1	4	i	-	S. 4,5,12:i:- (monofasic variant of Typhimurium)	no	10
S-1	4,5,12	i	-	4,5,12:i:-	yes	11
S-1	4,5,12	i	-	4,5,12:i:-	yes	12
S-1	4,5,12	i	-	4,5,12:i:-	no	13
S-1	4,5,12	i	-	monophasic Typhimurium	yes	14
S-1	4,5,12	i	-	4,5,12:i:-	no	15
S-1	4,5,12	i	-	4,5,12:i:-	no	16
S-1	4,5	i	-	Monophasic Typhimurium	yes	17
S-1	4,5	i	-	Monophasic variant of S. Typhimurium	no	18
S-1	4,5,12	i	-	4,5,12:i:-	yes	19
S-1	4,5,12	i	-	4,5,12:i:-	yes	20
S-1	4,5,12	i	-	4,5,12:i:-	no	21
S-1	1,4,[5],12	i	-	1,4,[5],12:i:-	no	22
S-1	4,5,12	i	-	4,5,12:i:-	yes	23
S-1	4,5,12	i	-	4,5,12:i:-	yes	24
S-1	4,5,12	i	-	4,5,12:i:-	no	25
S-1	4,5,12	i	-	4,5,12:i:-	no	26
S-1	4,5,12	i	-	4,5,12:i:- . Typhimurium monophasic variant	yes	27
S-1	4,5,12	i	-	Typhimurium, monophasic (4,5,12:i:-)	yes	28
S-1	4,5	i	-	Monophasic S. Typhimurium 4,5:i:-	yes	29
S-1	4,5,12	i	-	4,5,12:i:-	no	30
S-1	4,5	i	-	4,5:i:-	no	31
S-1	4,5,12	i	-	4,5,12:i:-	yes	32
S-1	4,5,12	i	-	4,5,12:i:-	yes	33
S-1	4,5,12	i	-	4,5,12:i:-	yes	34
S-1	4,5,12	i	-	4,5,12:i:-	no	35

Strain code	O-antigens	H-antigens (phase 1)	H-antigens (phase 2)	Serovar	Lab code
S-21	50	k	z	50:k:z (IIIb)	REF
S-21	50	k	z	Hemingford IIIb	1
S-21	61	-	-	61: - : -	2
S-21	50	k	z	50:k:z	3
S-21	50	k	no further	enterica subsp. diarizonae	4
S-21	50	k	z	50:k:z	5
S-21					6
S-21	50	k	z	SIII 50:k:z	7
S-21					8
S-21	50	k	z	50:k:z	9
S-21					10
S-21	50	k	z	50:k:z	11
S-21	50	k	z	IIIb: 50:k:z	12
S-21	50	k	z	50:k:z	13
S-21	-	k	-	-:k:-	14
S-21	50	k	z	50:K:Z sg III b	15
S-21	50	k	z	S. IIIb (Salmonella enterica subsp. diarizonae) 50:k:z	16
S-21	50	k	z	IIIb: 50:k:z	17
S-21	50	k	z	IIIb 50:k:z	18
S-21	61	k	-	61:k:- IIIb	19
S-21	50	k	z	50:k:z	20
S-21	50	k	z	IIIb	21
S-21	50	k	1,5,7	S. enterica subsp. diarizonae /IIIb/	22
S-21	50	k	z	50:k:z	23
S-21	50	k	z	50:k:z	24
S-21	50	k	z	50:k:z	25
S-21	50	k	z	50:k,z	26
S-21	50	k	z	50:k:z. S. enterica subsp. diarizonae	27
S-21	50	k	z	Salmonelle enterica subsp. diarizonae serovar 50 : k z	28
S-21	50	k	z	S. enterica subsp. diarizonae 50:k:z	29
S-21					30
S-21	?	k	z	?:k:z	31
S-21	50	k	z	III a arizonae	32
S-21	50	k	z53	50:k:z53 (IIIb)	33
S-21	50	k	z	S.IIIb 50:k:z	34
S-21	50	k	z	IIIb 50:k:z	35

Annex C. Details per strain that caused problems in serotyping

Strain code	O-antigens	H-antigens (phase 1)	H-antigens (phase 2)	Serovar	Lab code
S-1	1,4,[5],12	f,g,s	[1,2]	Agona	REF
S-1	4,12	f,g	-	Derby	1
S-3	3,{10},{15}	r	z6	Weltevreden	REF
S-3	3,10	r	1,5	Ughelli	1
S-3	3,10	r	-	3,10:r:-	2
S-3	3,10	r	z6	Weltewreden	10
S-4	28	i	1,5	Cotham	REF
S-4	-	i	1,5	-:i:1,5	2
S-4		i	1,5		30
S-5	1,9,12	a	e,n,z15	Durban	REF
S-5	9,12	a	enz15	Burban	1
S-8	1,9,12	l,z13	e,n,x	Napoli	REF
S-8	9	l,v	e,n,x	9:l,v:e,n,x	2
S-8	1,9,12	-	e,n,x	1,9,12:-:e,n,x	21
S-9	1,13,22	z	1,6	Poona	REF
S-9	-	-	-	-:-:-	2
S-9	12,22	z	6	Poona	32
S-11	1,13,23	y	l,w	Ordonez	REF
S-11	-	y	l,w	-:y:l,w	2
S-11	23	-	w	23:-:w	33
S-11	13,23	-	l,w	13,23:-:l,w	34
S-12	8,20	r,[i]	z6	Altona	REF
S-12	8	r	-	8:r:-	2
S-13	6,7,14	z10	l,w	Jerusalem	REF
S-13	6,7	z10	l,w	Jeruzalem	17
S-13	6,7	z10	l,w	Jarusalem	21
S-15	1,4,[5],12,[27]	d	1,2	Stanley	REF
S-15	1,4,12	d	1,5	Eppendorf	30
S-18	11	r	e,n,x	Rubislaw	REF
S-18	11	-	-	11:-:-	2
S-18	'o' rough	r	e,n,x	'o' rough:r:e,n,x	15
S-18	11	r	e,n,x	Ribislaw	30
S-20	6,7,14	z10	e,n,z15	Mbandaka	REF
S-20	6,7	k	enz15	Escanaba	1
S-20	6,7	z10	e,n,x	Mbandaka	6
S-20	spontaneous agglutination				33

	remark (eg spelling error)
	not typable (eg antisera not available, rough)
	partly correct, in the naming: no penalty points
	incorrect, in the naming: 1 penalty point
	incorrect, in the naming: 4 penalty points