



# Interim Summary Report

## EURL-*Salmonella* Proficiency Test Serotyping 2021

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### 1. Introduction

This interim summary report describes the overall results on the serotyping part of the Proficiency Test (PT) on typing of *Salmonella*, organised by the European Union Reference Laboratory for *Salmonella* (EURL-*Salmonella*, Bilthoven, the Netherlands) in November 2021. Results regarding the part on Cluster Analysis (CA) will be reported separately. A total of 35 laboratories participated in the PT 2021. These included 27 National Reference Laboratories for *Salmonella* (NRLs-*Salmonella*) in the 27 EU Member States and 8 NRLs from third countries (EU candidate or potential EU candidate Member States, members of the European Free Trade Association (EFTA), and the United Kingdom). The main objective of this PT was to evaluate the performance of the NRLs for serotyping of *Salmonella*.

### 2. Materials and Methods

#### 2.1. *Salmonella* strains for serotyping

A total of 20 *Salmonella* strains (coded S1 - S20) had to be serotyped by the participants. As agreed at the 26<sup>th</sup> EURL-*Salmonella* Workshop (Mooijman, 2021), a less common strain (S21) was additionally included. Testing this strain was optional and results were not included in the evaluation.

The *Salmonella* strains used for the PT on serotyping originated from the National *Salmonella* Centre collection in the Netherlands. The strains were verified by the Centre before distribution. The complete antigenic formulas of the 21 serovars, in accordance with the most recent White-Kauffmann-Le Minor scheme (Grimont and Weill, 2007), are shown in Table 1. However, participants were asked to report only those results, on which the identification of serovar names was based. Three strains (Table 1) represented serovars included in the EURL-*Salmonella* serotyping PTs for the first time.

#### 2.2 Laboratory codes

Each participant was randomly assigned a laboratory code 1 - 35.



Table 1. Antigenic formulas of the 21 *Salmonella* strains according to the White-Kauffmann-LeMinor scheme used in the EURL-*Salmonella* PT Serotyping 2021

Strain code	O-antigens	H-antigens (phase 1)	H-antigens (phase 2)	Serovar
S1	<u>1</u> ,9,12	g,m	-	Enteritidis
S2 <sup>a)</sup>	11	e,h	1,2	Chingola
S3 <sup>a)</sup>	<u>1</u> ,4,12,27	b	e,n,z15	Wagenia
S4	4,[5],12	l,v	e,n,z15	Brandenburg
S5	3,{10}{15}{15,34}	y	1,5	Orion
S6	<u>6</u> ,7, <u>14</u>	e,h	e,n,z15	Braenderup
S7	{ <u>6</u> ,7, <u>14</u> }{54}	g,m,[p],s	[1,2,7]	Montevideo
S8 <sup>b)</sup>	<u>1</u> ,4,[5],12	i	-	4,5,12:i:-
S9 <sup>a)</sup>	<u>1</u> ,4,12,[27]	b	l,w	Wien
S10	<u>6</u> ,7, <u>14</u>	r	1,2	Virchow
S11	<u>1</u> ,9,12	l,z13	e,n,x	Napoli
S12	8, <u>20</u>	z38	-	Apeyeme
S13	<u>6</u> ,7, <u>14</u>	r	1,5	Infantis
S14	28	z10	e,n,x	Umbilo
S15	6,8	z10	e,n,x	Hadar
S16	4,[5],12	a	1,7	Arechavaleta
S17	3,{10}{15}{15,34}	e,h	1,6	Anatum
S18	<u>6</u> ,8, <u>20</u>	r,[i]	1,5	Bovismorbificans
S19	<u>1</u> ,4,[5],12	i	1,2	Typhimurium
S20	<u>1</u> ,13,23	z29	-	Cubana
S21 <sup>c)</sup>	50	r	1,5,(7)	50:r:1,5 (IIIb)

<sup>a)</sup> Represented in an EURL-*Salmonella* PT Serotyping for the first time.

<sup>b)</sup> monophasic variant of Typhimurium as determined by PCR.

<sup>c)</sup> *Salmonella enterica* subspecies *diarizonae* (optional strain).

## 2.3 Transport

The parcels containing the strains for typing were sent by the EURL-*Salmonella* on 8 November 2021. All samples were packed and transported as Biological Substance Category B (UN 3373) and transported by a door-to-door courier service.

## 2.4 Evaluation of the serotyping results

The evaluation of the serotyping results 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, the following criteria for 'good performance' in PTs on serotyping were defined (Mooijman, 2007).

Penalty points are given for the incorrect typing of strains, but a distinction is made between the five most important human health-related *Salmonella* serovars (as indicated in EU legislation, also sometimes referred to as 'top-5'), 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 five serovars to another strain.
- 1 penalty point: incorrect typing of all other *Salmonella* serovars.

The total number of penalty points is calculated for each NRL-*Salmonella*. The criterion for good performance is set at less than four penalty points.

All EU Member State NRLs not meeting the criterion of good performance (scoring four penalty points or more) have to participate in a follow-up study, in which 10 additional strains have to be serotyped.

### 3. Results

#### 3.1 Serotyping results of the NRLs-*Salmonella*

##### 3.1.1. General comments on this year's evaluation

As decided at the 26<sup>th</sup> EURL-*Salmonella* Workshop (online, 28 May 2021), 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 type of errors for O- and H-antigens and for identification of the strains are shown in Figures 1, 2, and 3.

The percentages of correct results per laboratory are shown in Figure 4.

The O-antigens were typed completely correctly by 32 of the 35 participants (91%). This corresponds to nearly 100% of the total number of strains. The H-antigens were typed completely correctly by 26 of the 35 participants (74%), corresponding to 98% of the total number of strains. As a result, 26 participants (74%) reported all serovar names correctly, which corresponds to 98% of all strains evaluated.

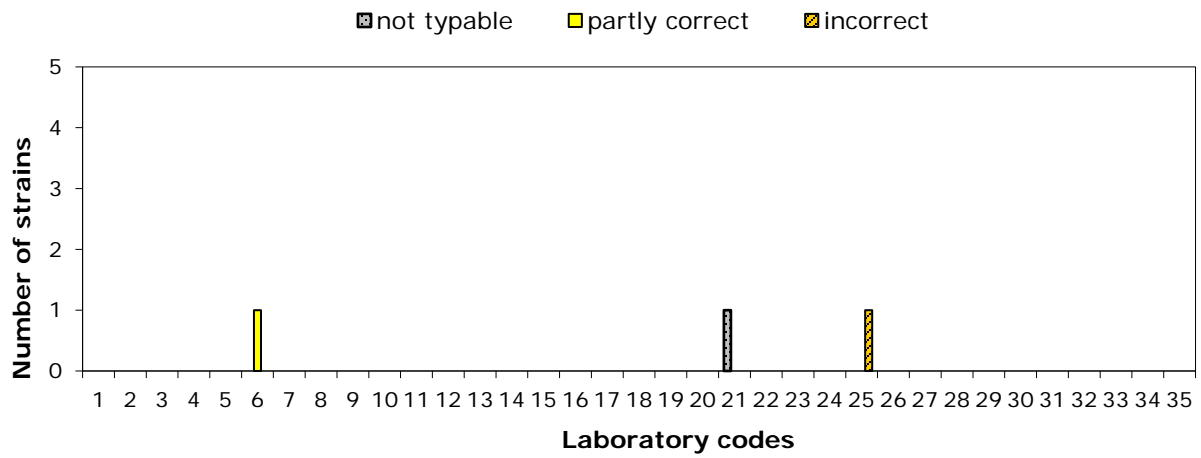


Figure 1. Evaluation of the type of errors for O-antigens, per participant

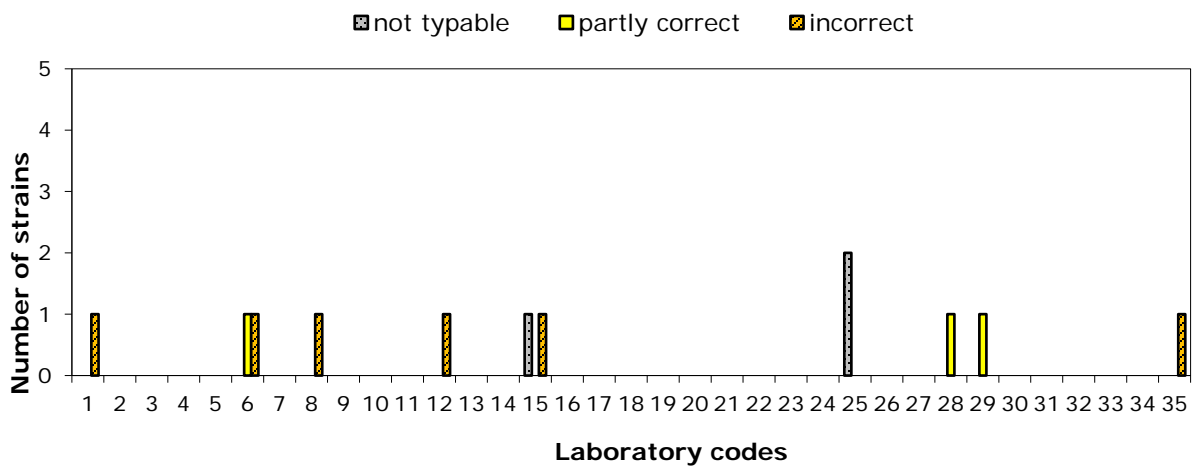


Figure 2. Evaluation of the type of errors for H-antigens, per participant

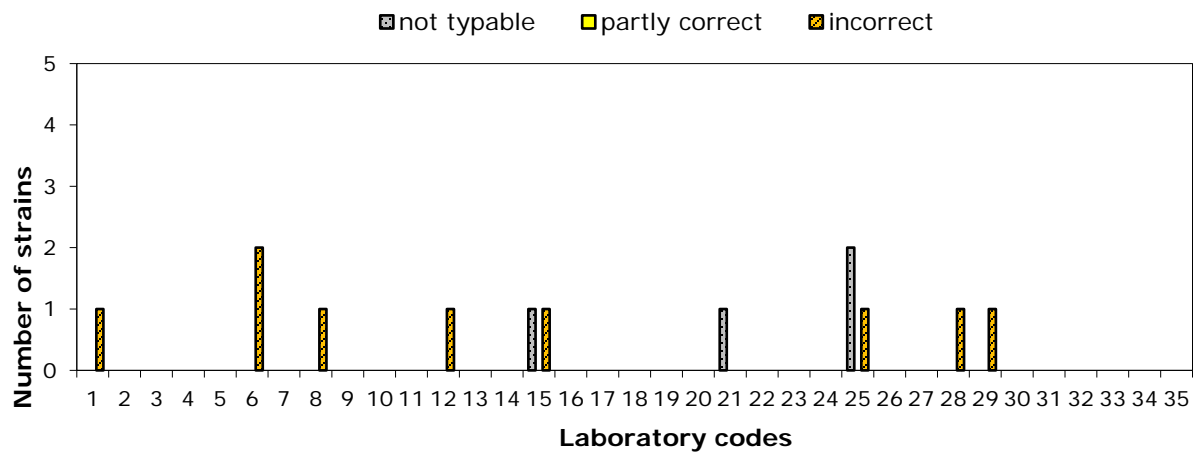


Figure 3. Evaluation of the type of errors in the identification of the serovar names, per participant

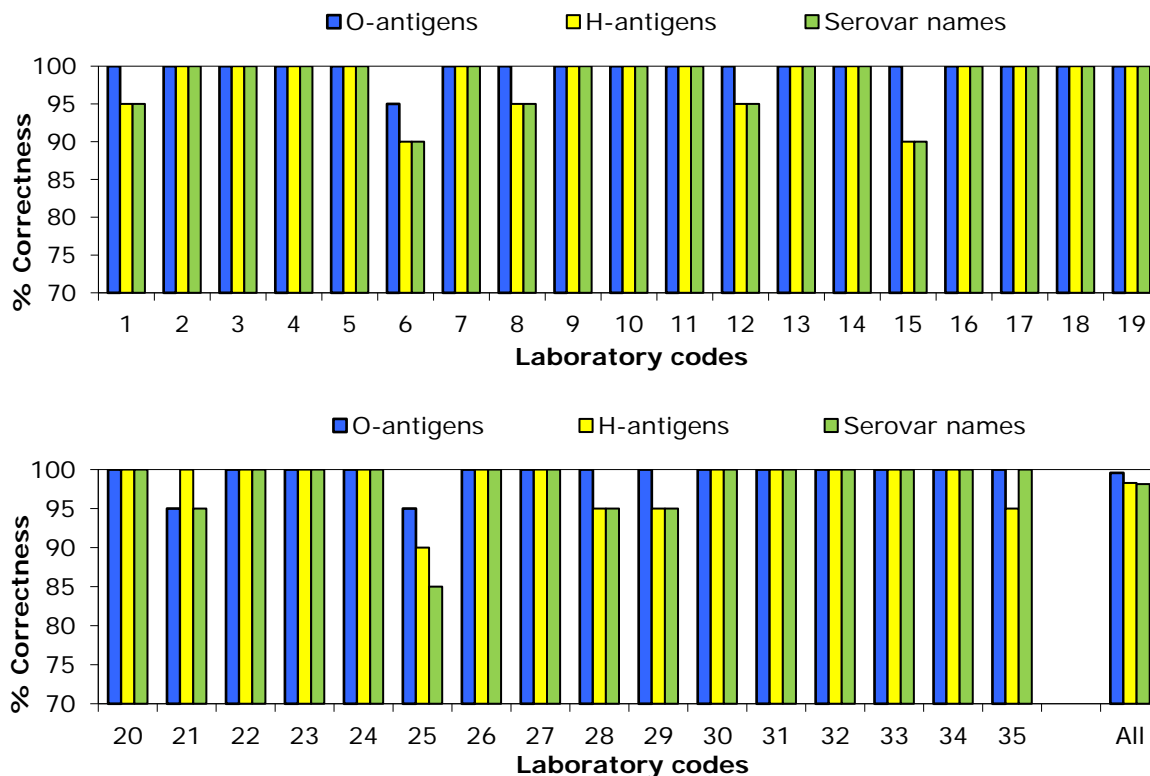


Figure 4. Percentages of correct serotyping results, per participant

The number of penalty points was determined for each NRL using the guidelines described in section 2.4. Table 3 shows the number of penalty points for each NRL and indicates whether the level of good performance was achieved (yes or no). Overall, the performance of the participants in the PT Serotyping 2021 was very good. One EU Member State NRL (Lab 12) did not meet the level of good performance at the first stage of the study and a follow-up study for this laboratory will be organised.



Table 3. Evaluation of serotyping results per NRL

Lab code	Penalty points	Good performance	Lab code	Penalty points	Good performance
1	1	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	2	yes	24	0	yes
7	0	yes	25	1	yes
8	1	yes	26	0	yes
9	0	yes	27	0	yes
10	0	yes	28	1	yes
11	0	yes	29	1	yes
12	4	<b>NO</b>	30	0	yes
13	0	yes	31	0	yes
14	0	yes	32	0	yes
15	1	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

Final naming results reported per strain (S1 – S20) and per laboratory (1 - 35) are given in Annex A.

A completely correct identification was obtained for ten *Salmonella* serovars: Enteritidis (S1), Chingola (S2), Braenderup (S6), Montevideo (S7), Wien (S9), Virchow (S10), Infantis (S13), Hadar (S15), Anatum (S17), and Typhimurium (S19).

The reported serovar names for strain 1,4,[5],12:i:- (S8) are also shown in Annex A. Fifteen participants used a PCR method to confirm this strain to be monophasic Typhimurium.

Details on the additional and optional strain S21 are given in Annex B. All but three participants tried to serotype strain S21, a *Salmonella enterica* subsp. *diarizonae* (IIIb). A few laboratories did not have access to the required antisera to finalise this (50:r:1,5). Details on the strains that caused problems in serotyping are shown in Annex C.



## References

Grimont, P.A.D. and Weill, F-X., 2007. Antigenic formulae of the *Salmonella* serovars, 9<sup>th</sup> ed. WHO Collaborating Centre for Reference and Research on *Salmonella*. Institute Pasteur, Paris, France.

[https://www.pasteur.fr/sites/default/files/veng\\_0.pdf](https://www.pasteur.fr/sites/default/files/veng_0.pdf) (accessed 21/2/2022).

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](http://www.eurlsalmonella.eu/Publications/Workshop_Reports) (accessed 21/2/2022).

Mooijman, K.A., 2021. The 26<sup>th</sup> EURL-*Salmonella* workshop; 28 May 2021, online. National Institute for Public Health and the Environment, Bilthoven, the Netherlands. Report no.: 2021-0130.

([http://www.eurlsalmonella.eu/Publications/Workshop\\_Reports](http://www.eurlsalmonella.eu/Publications/Workshop_Reports) (accessed 21/2/2022)).

## 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

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## Annex A. Serotyping results per strain and laboratory






Lab: S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
REF	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i:-	Wien Virchow
1	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4, 5,12:i: -	Wien Virchow
2	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	Typhimurium, monophasic (4,5,12:i:-)	Wien Virchow
3	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
4	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	Monophasic Salmonella typhimurium	Wien Virchow
5	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
6	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12 : i : -	Wien Virchow
7	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
8	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	monophasic Typhimurium	Wien Virchow
9	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,[5],12:i:-	Wien Virchow
10	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i:-	Wien Virchow
11	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,12:i:-	Wien Virchow
12	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i:e,n,x	Wien Virchow
13	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12: i: -	Wien Virchow
14	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
15	Enteritidis	Chingola	Wagenia	Brandenburg	/	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
16	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
17	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
18	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
19	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
20	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
21	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5:i:-	Wien Virchow
22	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
23	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4:i:-	Wien Virchow
24	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
25	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
26	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	Typhimurium monophasic Variant	Wien Virchow
27	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	Monophasic 4,5,12:i: -	Wien Virchow
28	Enteritidis	Chingola	Abony	Brandenburg	Orion	Braenderup	Montevideo	1,4,5,12:i: -	Wien Virchow
29	Enteritidis	Chingola	Wagenia	Kimuenza	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
30	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: -	Wien Virchow
31	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	1,4,[5],12:i: -	Wien Virchow
32	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5:i:-	Wien Virchow
33	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4, 5, 12: i: -	Wien Virchow
34	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: - (mST)	Wien Virchow
35	Enteritidis	Chingola	Wagenia	Brandenburg	Orion	Braenderup	Montevideo	4,5,12:i: - (monophasic Typhimurium)	Wien Virchow
X	0	0	1	1	0	0	0	1	0 0





S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	Lab:
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	REF
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Kisangani	Anatum	Bovismorbificans	Typhimurium	Cubana	1
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	2
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	3
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	4
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	5
Nordrhein	Albany	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	6
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	7
Lomalinda	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	8
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	9
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	10
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	11
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	12
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	13
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	14
Lomalinda	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	15
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	16
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	17
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	18
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	19
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	20
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	- : r: 1,5	Typhimurium	Cubana	21
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	22
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	23
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	24
Napoli	8,20: HME: -	Infantis	Djibuti	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	13,23: HME: -	25
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	26
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	27
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	28
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	29
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	30
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	31
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	32
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	33
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	34
Napoli	Apeyeme	Infantis	Umbilo	Hadar	Archavaleta	Anatum	Bovismorbificans	Typhimurium	Cubana	35
3	1	0	1	0	1	0	0	0	0	X



	remark (e.g., spelling error)
	not typable (e.g., antisera not available, rough strain)
	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 strain S21 are given in Annex B.



## Annex B. Details on serotyping results strain S21

Strain code	O-antigens	H-antigens (phase 1)	H-antigens (phase 2)	Serovar	Lab code
<b>S-21</b>	<b>50</b>	<b>r</b>	<b>1,5,(7)</b>	<b>50:r:1,5 (IIIb)</b>	<b>REF</b>
S-21	50	r	1,5,7	Salmonella enterica subspecies diarizonae serovar 50:r:1,5,7	1
S-21	50	r	1,5,7	Salmonella enterica subspecies diarizonae serovar 50:r:1,5,7	2
S-21	50	r	1,5,7	50:r:1,5,7	3
S-21	50	r	1,5,7	III b	4
S-21	50	r	1,5	IIIb 50:r:1,5	5
S-21	OME	r	1,5,7	OME : r : 1,5,7 (IIIb)	6
S-21	50	r	5	S. IIIb (S. enterica subsp. diarizonae) 50:r:1,5,(7)	7
S-21	-	-	-	-	8
S-21	50	r	1,5,(7)	50:r:1,5,(7)	9
S-21	50 or 61	r	1,5,7	IIIb 50 or 61:r:1,5,7	10
S-21	50	r		S. enterica ssp. diarizonae IIIb	11
S-21	61	r	1,5,7	61:r:1,5,7	12
S-21	50	r	1,5	50:r:1,5 (IIIb)	13
S-21	50	r	1,5,7	50:r:1,5,7	14
S-21					15
S-21	50	r	1,5,7	50:r:1,2,7	16
S-21	50	r	1,5,7	IIIb 50:r:1,5,7	17
S-21	61	r	1,5,7	61:r:1,5,7 (IIIb)	18
S-21	50	r	1,5,7	IIIb 50:r:1,5,7	19
S-21	50	r	1,5,7	50:r:1,5,7 (IIIb)	20
S-21	50	r	1,5,7	IIIb, 50:r:1,5,7	21
S-21	50	r	1,5,7	IIIb 50:r:1,5,(7)	22
S-21	50	r	1,5,7	S.enterica subsp. diarizonae	23
S-21	50	r	1,5,7	50:r:1,5,7	24
S-21	OME	-	-	OME:-:-	25
S-21	50	r	1,5	IIIb 50 : r : 1,5,(7)	26
S-21	50	r	1,5,7	50:r:1,5,7 sg IIIb	27
S-21	50	r	1,5	Salmonella enterica subspecies diarizonae 50:r:1,5	28
S-21	50	l,v	z67	(VI)50:l,v:z67	29
S-21					30
S-21	50	r	1,5(7)	50:r:1,5,(7) - IIIb	31
S-21	61	r	5,7	61:r:5,7 (IIIb)	32
S-21					33
S-21	50	r	1,5,7	50:r:1,5,7 (IIIb)	34
S-21	50	r	1,5,7	IIIb 50:r:1,5,7	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-3	<u>1,4,12,27</u>	b	e,n,z15	Wagenia	REF
S-3	4,12,27	b	e,n,x	Abony	28
S-4	4,[5],12	l,v	e,n,z15	Brandenburg	REF
S-4	4	l,v	e,n,z15	Brandenburg	21
S-4	4	l,v	e,nZ15	Brandenburg	23
S-4	4,12	l,v	e,n,x	Kimuenza	29
S-5	3,{10}{15}{15,34}	y	1,5	Orion	REF
S-5	3,10	y	/	/	15
S-6	6,7, <u>14</u>	e,h	e,n,z15	Braenderup	REF
S-6	6,7	e,h	e,nZ15	Braenderup	23
S-8	<u>1,4,[5],12</u>	i	-	4,5,12:i:-	REF
S-8	4,5,12	i	e,n,x	4,5,12:i:e,n,x	12
S-8	4,5,12	i	1,2	4,5,12:i:- (monophasic Typhimurium)	35
S-11	<u>1,9,12</u>	l,z13	e,n,x	Napoli	REF
S-11	9,46	l,z13,z28	e,n,z15	Nordrhein	6
S-11	9	a	e,n,x	Lomalinda	8
S-11	9	a	e,n,x	Lomalinda	15
S-12	<u>8,20</u>	z38	-	Apeyeme	REF
S-12	8,20	z4,z24	-	Albany	6
S-12	8,20	HME	-	8,20:HME:-	25
S-14	28	z10	e,n,x	Umbilo	REF
S-14	17	z10	e,n,x	Djibuti	25
S-15	6,8	z10	e,n,x	Hadar	REF
S-15	6,8	Z10	e,n,x	Hadar	11
S-16	4,[5],12	a	1,7	Archavaleta	REF
S-16	4,5,12	a	1,2	Kisangani	1
S-16	4,5,12	a	1,7	Archavaleta	2
S-16	4,5,12	a	1,7	Archavaleta	12
S-18	<u>6,8,20</u>	r,[i]	1,5	Bovismorbificans	REF
S-18	-	r	1,5	--:r:1,5	21
S-18	6,8	r	s	Bovismorbificans	32
S-20	<u>1,13,23</u>	z29	-	Cubana	REF
S-20	13,23	HME	-	13,23:HME:-	25

	Reference strain
	remark (e.g. spelling error)
	not typable (e.g. antisera not available, rough strain)
	partly correct; in the naming: no penalty points
	incorrect; in the naming: 1 penalty point
	incorrect; in the naming: 4 penalty points