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Thirteenth CRL-*Salmonella* inter-laboratory comparison study (2008) on typing of *Salmonella* spp.

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Abstract

Thirteenth CRL-*Salmonella* interlaboratory comparison study (2008) on typing of *Salmonella* spp.

The National Reference Laboratories (NRLs) of all 27 European Member States performed well on the 2008 quality control test on *Salmonella* typing. The 4 laboratories which repeated the test also obtained good scores. An analysis of the pooled results from all NRLs revealed that the NRLs taken as a whole were able to assign the correct name to 97 % of the strains tested. One NRL performed the test at a relatively late date and, consequently, its data could not be included in the group analysis.

Since 1992, the NRLs have been required to participate in an annual quality control test, which consists of an interlaboratory comparison study for *Salmonella* typing. Each Member State designates a specific laboratory within their national boundaries to be responsible for the detection and identification of *Salmonella* strains from samples isolated from animals and/or food products. These laboratories are then referred to as the National Reference Laboratories. The performance of the NRLs is assessed annually based on their capability to correctly identify 20 *Salmonella* strains. NRLs from countries outside the European Union occasionally participate in these tests, and NRLs from 2 countries belonging to the European Free Trade Association (EFTA) took part in the 2008 test.

The expertise of a number of NRLs was subjected to more severe testing by having not only to identify the 20 *Salmonella* strains of the quality control test but also to subtype (phage typing) various other *Salmonella* strains. As such, these laboratories received 10 strains of each of *Salmonella* Enteritidis and *Salmonella* Typhimurium. These NRLs typed 97 % of the *S. Typhimurium* strains correctly. The typing of *S. Enteritidis* strains proved to be more troublesome, with the NRLs typing 94 % of the strains correctly.

The Community Reference Laboratory for *Salmonella* (CRL-*Salmonella*) organises this annual interlaboratory comparison study in cooperation with the Health Protection Agency in London, UK. The CRL-*Salmonella* is situated at the National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands.

Key words:

CRL-*Salmonella*, *Salmonella* spp., serotyping, phage typing

Rapport in het kort

Dertiende CRL-*Salmonella* ringonderzoek (2008) voor de typering van *Salmonella* spp.

De Nationale Referentie Laboratoria (NRL's) van de 27 Europese lidstaten scoorden goed bij de kwaliteitscontrole op *Salmonella*-typering in 2008. Vier laboratoria hadden hiervoor een herkansing nodig. Daarnaast is een analyse van alle NRL's als groep uitgevoerd, waaruit bleek dat zij 97 % van de stammen de juiste naam konden geven. Aangezien een NRL de studie op een later tijdstip uitvoerde, konden deze data daar niet bij worden meegenomen.

Sinds 1992 zijn deze laboratoria verplicht om deel te nemen aan deze kwaliteitstoets, het zogeheten ringonderzoek voor de typering van *Salmonella*. Elke lidstaat wijst een laboratorium aan, het Nationale Referentie Laboratorium (NRL), dat *Salmonella* afkomstig uit monsters van levensmiddelen of dieren aantoonst en typeert. Jaarlijks wordt gecontroleerd of de laboratoria hun werk goed uitvoeren. Soms doen ook landen buiten de Europese Unie mee, zoals dit jaar twee landen die zijn aangesloten bij de European Free Trade Association (EFTA).

De laboratoria krijgen 20 stammen *Salmonella* opgestuurd waarvan zij de juiste naam moeten achterhalen. Enkele NRL's zijn bovendien op hun expertise getoetst om een subtypering van soorten *Salmonella* te maken. Ze kregen 10 stammen voorgelegd van 2 soorten, te weten *Salmonella* Enteritidis en *Salmonella* Typhimurium. De NRL's hebben 97 % van de *S. Typhimurium*-stammen goed getypeerd. Het was iets lastiger de *S. Enteritidis*-stammen te typeren. De NRL's konden 94 % van deze stammen goed typeren.

De organisatie van het ringonderzoek is in handen van het Communautair Referentie Laboratorium (CRL) voor *Salmonella* (CRL-*Salmonella*). Het CRL-*Salmonella* is ondergebracht bij het Nationaal Instituut voor Volksgezondheid en Milieu (RIVM), Bilthoven, Nederland. De organisatie van dit ringonderzoek wordt uitgevoerd in samenwerking met de Health Protection Agency (HPA) in Londen, Engeland.

Trefwoorden:

CRL-*Salmonella*, *Salmonella*, serotypering, faagtypering.

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Summary

In November 2008 the thirteenth interlaboratory comparison study on typing of *Salmonella* was organised by the EU Community Reference Laboratory for *Salmonella* (CRL-*Salmonella*, Bilthoven, the Netherlands) in collaboration with the Health Protection Agency (HPA, London, United Kingdom). The main objective of the study was to evaluate whether examination of samples by the National Reference Laboratories (NRLs-*Salmonella*) was carried out uniformly and whether comparable results were obtained.

Twenty-eight NRLs-*Salmonella* of the 27 Member States of the European Union participated, as well as the NRLs of Norway and Switzerland. All 30 NRLs performed serotyping. A total of 20 strains of the species *Salmonella enterica* subspecies *enterica* were selected for serotyping by the CRL-*Salmonella*. The strains had to be typed with the method routinely used in each laboratory, following the White-Kauffman-Le Minor scheme. The laboratories were allowed to send strains for serotyping to another specialised laboratory in their country. For 1 NRL many problems were faced with mailing of the parcel. The parcel was held up by customs and it was not possible to get it released. A new parcel was sent to this NRL in February 2009. Due to the delayed performance of the study, the results of this NRL could not be used for the analyses of the group results. The 29 NRLs, who performed the study in November 2008, were able to correctly type 98 % of the O-, and H-antigens and 97 % of the serovar names were assigned correctly.

At the CRL-*Salmonella* workshop in 2007, the CRL-*Salmonella* proposed a definition for good performance of the NRLs regarding the serotyping. Using this definition 25 NRLs achieved this level of good performance. Four NRLs which did not achieve the level of good performance received 10 extra strains for serotyping. All 4 NRLs achieved the level of good performance in this follow-up.

Seven of the participating NRLs-*Salmonella* also performed phage typing. The HPA selected 20 strains for phage typing, 10 were of the serovar *Salmonella* Enteritidis (SE) and 10 of the serovar *Salmonella* Typhimurium (STM). The phage typing results of the majority of the laboratories were good.

The 7 NRLs phage typed 94 % of the *Salmonella* Enteritidis strains correctly and 97 % of the *Salmonella* Typhimurium strains.

1 Introduction

This report describes the thirteenth interlaboratory comparison study on the typing of *Salmonella* spp. organised by the Community Reference Laboratory for *Salmonella* (CRL-*Salmonella*, Bilthoven, the Netherlands), in November 2008.

According to the Regulation (EC) no 882/2004 it is one of the tasks of the CRL-*Salmonella* to organise interlaboratory comparison studies for the National Reference Laboratories for *Salmonella* (NRLs-*Salmonella*) of the European Union. The main objective is that the examination of samples in the Member States will be carried out uniformly and comparable results will be obtained. The organisation of the typing studies started in 1995.

30 National Reference Laboratories for *Salmonella* (NRLs-*Salmonella*) participated in this study. The main objectives of this study were 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 which did not achieve the level of good performance, defined by the CRL-*Salmonella*, had to participate in a follow-up study in which 10 extra strains were serotyped.

Seven of the NRLs-*Salmonella* performed phage typing on 10 *Salmonella* Enteritidis and 6 of the NRLs-*Salmonella* performed phage typing on 10 *Salmonella* Typhimurium strains. The selection of the strains and interpretation of the results of the phage typing were performed in close cooperation with the Health Protection Agency, London, UK.

2 Participants

Country	Institute/City
Austria	Institute for Medical Microbiology and Hygiene (AGES) NRC <i>Salmonella</i> Graz
Belgium	Veterinary and Agrochemical Research Centre (VAR) CODA Brussels
Bulgaria	National Diagnostic Science and Research Veterinary Medical Institute Sofia
Cyprus	Laboratory for the Control of Foods of Animal Origin (LCFAO) Natural Resources and Environment Veterinary Services Nicosia
Czech Republic	State Veterinary Institute National Reference Laboratory for Salmonellosis Prague
Denmark	National Food Institute Department of Microbiology and Risk Assessment Copenhagen
Estonia	Estonian Veterinary and Food Laboratory Diagnostic Department, Bacteriological Laboratory Tartu
Finland	Finnish Food Safety Authority EVIRA Animal Disease and Food Safety Research Kuopio
France	Agence Française de Sécurité Sanitaire des Aliments (AFSSA) Laboratoire d'Etudes et de Recherches Avicoles et Porcines Ploufragan
Germany	Federal Institute for Risk Assessment (BfR) National Veterinary <i>Salmonella</i> Reference Laboratory Berlin
Greece	Veterinary Laboratory of Halkis Halkis
Hungary	Central Agricultural Office, Food and Feed Directorate Department Food Microbiology Budapest
Ireland	Central Veterinary Research Laboratory Department of Agriculture and Food Dublin
Italy	Istituto Zooprofilattico Sperimentale delle Venezie Legnaro
Latvia	National Diagnostic Centre (NDC) Riga
Lithuania	National Veterinary Laboratory Vilnius

Country	Institute/City
Luxembourg	Laboratoire de Médecine Vétérinaire de l'Etat Animal Zoonosis Luxembourg
Malta	Public Health Laboratory Microbiology PHL Evans Building, Department of Public Health Valletta
the Netherlands	National Institute for Public Health and the Environment Laboratory for Zoonoses and Environmental Microbiology Bilthoven
Northern Ireland (UK)	Agri-Food and Biosciences Institute (AFBI) Veterinary Sciences Division, Bacteriological Department Belfast
Norway	Norwegian Institute of Public Health National Reference Laboratory for Enteropathogenic Bacteria Dept. of Foodborne Disease Oslo
Poland	National Veterinary Institute Microbiological Department Pulawy
Portugal	Laboratório Nacional de Veterinária Lisbon
Romania	INCDDMI 'Cantacuzino' Molecular Epidemiology Laboratory Bucharest
Slovak Republic	State Veterinary and Food Institute Reference laboratory for Salmonella Bratislava
Slovenia	National Veterinary Institute Veterinary Faculty Ljubljana
Spain	Laboratorio de Sanidad Y Produccion Animal de Algete Madrid
Sweden	National Veterinary Institute Department of Bacteriology Uppsala
Switzerland	Institute of Veterinary bacteriology National Centre for Zoonoses, Bacterial Animal Diseases and Antimicrobial Resistance (ZOBA) Bern
United Kingdom	Veterinary Laboratories Agency Department of Bacterial Diseases Addlestone

3 Materials and Methods

3.1 *Salmonella* strains for serotyping

Twenty strains for serotyping were sent to the participants. The *Salmonella* strains used for the interlaboratory comparison 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 formula, according to the most recent White-Kauffmann-Le Minor scheme (Grimont & Weill, 2007), of the 20 serovars are shown in Table 1.

Table 1 Antigenic formulas of the 20 *Salmonella* strains according to the White-Kauffmann-Le Minor scheme selected by the CRL-*Salmonella*

Group	Serovar	O-antigens	H-antigens
B	<i>S. Paratyphi</i> B var. Java	<u>1</u> ,4,[5],12	b : 1,2
	<i>S. Derby</i>	<u>1</u> ,4,[5],12	f,g : -
	<i>S. Typhimurium</i>	<u>1</u> ,4,[5],12	i : 1,2
	<i>S. Bredeney</i>	<u>1</u> ,4,12, <u>27</u>	l,v : 1,7
	<i>S. Brandenburg</i>	4,[5],12	l,v : e,n,z ₁₅
	<i>S. Heidelberg</i>	<u>1</u> ,4,[5],12	r : 1,2
	<i>S. Coeln</i>	<u>1</u> ,4,[5],12	y : 1,2
C1	<i>S. Virchow</i>	6,7, <u>14</u>	r : 1,2
	<i>S. Infantis</i>	6,7, <u>14</u>	r : 1,5
	<i>S. Colindale</i>	6,7	r : 1,7
	<i>S. Mbandaka</i>	6,7, <u>14</u>	z ₁₀ : e,n,z ₁₅
C2-C3	<i>S. Kottbus</i>	6,8	e,h : 1,5
	<i>S. Blockley</i>	6,8	k : 1,5
	<i>S. Hadar</i>	6,8	z ₁₀ : e,n,x
D1	<i>S. Enteritidis</i>	<u>1</u> ,9,12	g,m : -
	<i>S. Dublin</i>	<u>1</u> ,9,12	g,p : -
D2	<i>S. Plymouth</i>	9,46	d : z ₆
E1	<i>S. Give</i>	3,{10}{15}{15,34}	l,v : 1,7
E4	<i>S. Senftenberg</i>	1,3,19	g,s,t : -
G	<i>S. Worthington</i>	<u>1</u> ,13,23	z : l,w

3.2 *Salmonella* strains for phage typing

The *Salmonella* strains for phage typing were obtained from the collection of the *Salmonella* Reference Unit of the Laboratory of Gastrointestinal Pathogens (LGP), Health Protection Agency (HPA), London, UK. Ten strains of *Salmonella* Enteritidis and 10 strains of *Salmonella* Typhimurium were selected. The explanation of the various notations in Tables 2 and 3 and the tables in Appendix 6 are as follows:

-	=	no reaction
±	=	5-20 plaques
+	=	21-40 plaques
++	=	41-80 plaques
+++	=	81-100 plaques
scl	=	semi-confluent lysis
cl	=	confluent clear lysis
ol	=	confluent opaque lysis
<<	=	merging plaques towards semi-confluent lysis

Table 2 Phage reactions of the *Salmonella* Enteritidis strains determined by HPA

Phage type	Phages reactions at Routine Test Dilution																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	OL	SCL	CL	OL	CL	<OL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	SCL
1b	OL	SCL	CL	OL	CL	<OL	<CL	OL	<OL	<OL	CL	CL	CL	CL	SCL	CL	<OL
4	-	SCL	CL	OL	CL	<OL	CL	OL	OL	OL	CL	CL	CL	-	-	-	<OL
6	-	SCL	-	OL	-	<OL	-	OL	<OL	OL	-	-	-	-	-	-	<OL
6c	-	SCL	-	SCL	-	<OL	-	SCL	<OL	<OL	-	-	-	-	-	CL	<OL
8	-	-	<SCL	<OL	CL	<OL	SCL	OL	<OL	OL	SCL	CL	-	-	-	-	<OL
14b	-	-	-	±	-	SCL	-	-	±	-	-	-	-	-	-	-	OL
47	-	SCL	-	-	-	<OL	-	-	-	-	-	-	-	CL	-	-	-
59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
60	OL	-	CL	-	CL	SCL	-	OL	-	OL	-	CL	CL	CL	-	-	-

Table 3 Phage reactions of the *Salmonella* Typhimurium strains determined by HPA

Phage type	Phages reactions at Routine Test Dilution																	
	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
2	-	CL	CL	OL	CL	CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	CL
12	-	-	-	-	-	-	-	-	-	-	SCL	<CL	-	-	-	-	-	-
12a	-	-	-	-	-	-	-	±	-	-	OL	OL	-	-	-	-	<CL	-
18	-	-	-	-	-	-	-	-	-	<OL	-	-	-	SCL	-	<OL	SCL	SCL
36	CL	CL	CL	OL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
104	-	-	-	-	-	-	-	-	-	-	++	SCL	-	-	-	-	++	-
136	-	-	-	OL	CL	CL	-	-	-	CL	CL	CL	-	CL	CL	-	-	CL
193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Phages at Routine Test Dilution													Additional phages							
Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var 2	10 var 3	18	
2	CL	OL	OL	CL	CL	CL	<CL	CL	-	CL	CL	OL	+++	+	++	OL	OL	SCL	OL	
12	-	-	-	-	-	-	-	-	-	-	-	-	+++	++	+++	OL	OL	++	-	
12a	-	±	-	-	-	-	-	++	-	-	-	OL	++	+	++	OL	OL	++	±	
18	SCL	-	-	-	-	-	-	+	-	-	OL	±	+++	++	+++	OL	<OL	+	-	
36	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	+++	++	+++	OL	OL	++	OL	
104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	+++	-	
136	+	-	-	-	-	OL	-	-	-	-	-	-	-	-	-	SCL	SCL	++	-	
193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-	
208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	+++	+	OL	
U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	-	

3.3 Laboratory codes

The NRLs-*Salmonella* were assigned a laboratory code 1-30 by CRL-*Salmonella*, which differed from the previous typing studies.

3.4 Protocol and test report

Four weeks before the start of the study the NRLs received the protocol and a test report via the e-mail. This protocol and test report can be found in Appendices 1 and 2.

3.5 Transport

All samples were packed and transported as diagnostic specimens and transported by door-to-door courier service. The parcels containing strains for serotyping and phage typing for the NRLs were sent by CRL-*Salmonella* in week 47, 2008.

3.6 Guidelines for evaluation

The evaluation of the various serotyping results as mentioned in this report is described in Table 4.

Table 4 Evaluation of serotyping results

Results of serotyping	Evaluation
Auto agglutination or incomplete set of antisera (outside the range of antisera)	nt = not typable
Partly typable due to incomplete set of antisera or part of the formula (for the name of the serovar)	+/- = partly correct
Wrong serovar or mixed sera formula	- = incorrect

At the CRL-*Salmonella* workshop in Bilthoven in May 2007 (Mooijman, 2007), the CRL-*Salmonella* has made a proposal for the level of 'Good performance' which the NRLs need to achieve during an interlaboratory comparison study on serotyping. Penalty points are given for strains that are typed incorrectly. A distinction is made between the five most important *Salmonella* serotypes (as indicated in EU legislation) and all other strains:

- **Four penalty points:** Incorrect typing of *S. Enteritidis*, *S. Typhimurium*, *S. Hadar*, *S. Infantis* or *S. Virchow* **or** assigning the name of one of these 5 serotypes to another strain.
- **One penalty point:** Incorrect typing of all other *Salmonella* serotypes.

For each NRL-*Salmonella* the total amount of penalty points is determined. The NRLs will reach the level of 'Good Performance' if they have less than 4 penalty points. A follow-up will occur for NRLs with 4 penalty points or more.

3.7 Follow-up

The follow-up for serotyping consisted of typing an extra set of 10 *Salmonella* strains. The strains for the follow-up are shown in Table 5. All NRLs with 4 penalty points or more had to participate in this follow-up. The protocol and test report for the follow-up is shown in Appendices 3 and 4.

Table 5 Antigenic formulas of the 10 *Salmonella* strains used in the follow up according to the White-Kauffmann-Le Minor scheme selected by the CRL-*Salmonella*

Group	Serovar	O-antigens	H-antigens
B	S. Typhimurium	<u>1</u> ,4,[5],12	i : 1,2
C1	S. Virchow	6,7, <u>14</u>	r : 1,2
C2-C3	S. Blockley	6,8	k : 1,5
	S. Hadar	6,8	z ₁₀ : e,n,x
D1	S. Enteritidis	<u>1</u> ,9,12	g,m : -
	S. Dublin	<u>1</u> ,9,12	g,p : -
D2	S. Wernigerode	9,46	f,g : -
E4	S. Senftenberg	1,3,19	g,s,t : -
	S. Cannstatt	1,3,19	m,t : -
G	S. Kedougou	<u>1</u> ,3,23	i : l,w

4 Questionnaire

4.1 General

A questionnaire was incorporated in the test report of the interlaboratory comparison study (see Appendices 2 and 4). In this part of the report the questions and answers of this questionnaire are summarised.

4.2 General questions

Question 1: Was your parcel containing the strains damaged at arrival?

All packages were received in a perfect state and no damage occurred during transport.

Question 2: What was the date of receipt of the parcel at the laboratory?

All, but 5 NRLs received their package in the same week as it was sent (week 47 of 2008). Four NRLs received their package in week 48 of 2008. One NRL did not mention the date the package was received but according to the courier service it was delivered in week 48 of 2008. For 1 NRL (laboratory 15) there were some troubles with the costumer services and the package could not be delivered. A new parcel was sent to this NRL in week 8 of 2009 and received in week 9. When this latter parcel is not taken into account, the average transport time of the parcels to the NRLs was 2.7 days.

Question 3: What kind of medium did you use for sub-culturing the strains?

The NRLs used a variety of media from various manufacturers for the sub-culturing of the *Salmonella* strains. This varied from non-selective nutrient agar to selective media like XLD or BGA.

4.3 Questions regarding serotyping

Question 4: What was the frequency of serotyping at your laboratory in 2007?

Question 5: How many strains did your laboratory serotype in 2007?

Replies to questions 4 and 5 are summarised in Table 6.

Table 6 Frequency and number of strains serotyped in 2007

Laboratory code NRLs	Typing frequency	Number of strains serotyped in 2007	Laboratory code NRLs	Typing frequency	Number of strains serotyped in 2007
1	Daily	12043	16	Twice a week	331
2	Weekly	185	17	None	0
3	Daily	4739	18	Thrice a week	1136
4	Daily	2300	19	NI	118
5	Daily	5490	20	Daily	1900
6	Daily	4460	21	Daily	3200
7	Daily	6180	22	Twice a week	1500
8	Once a week	4284	23	Once a week	211
9	Daily	6200	24	Twice a week	219
10	Once/Twice a week	65	25	Twice a week	95
11	Daily	823	26	Daily	2042
12	Thrice a week	463	27	Daily	450
13	Daily	1000	28	Daily	1000
14	Daily	380	29	Daily	500
15	NI	170	30	Thrice a week	200

NI = Not indicated on the test report

Question 6: How many of these typings considered a rough strain?

Two NRLs (laboratories 15 and 21) did not report the amount of rough strains and 1 NRL (labcode 2) did not know the amount of rough strains. Zero rough strains were reported by 9 NRLs (laboratory codes 10, 11, 14, 16, 17, 23, 24, 25 and 29). Five NRLs (laboratory codes 12, 19, 27, 28 and 30) reported between 1 – 10 rough strains, 11 NRLs (laboratory codes 3, 4, 6, 7, 8, 9, 13, 18, 20, 22 and 26) reported 10 – 100 rough strains and 2 NRLs (laboratory codes 1 and 5) reported > 100 rough strains. In percentages 0 – 8 % of all strains serotyped were rough strains in 2007.

Question 7: What kind of sera do you use (commercially available or prepared in own laboratory)?

The replies to question 7 are summarised in Tables 7 and 8.

Table 7 Number of laboratories using sera from one or more manufacturers and/or in-house prepared sera

Number of manufacturers where sera are obtained	Number of NRLs (n=30)
From 1 manufacturer	5
From 2 manufacturers	9
From 3 manufacturers	8
From 4 manufacturers	5
From 5 manufacturers or more	2
Preparation in own laboratory	1

Table 8 Number of laboratories using sera from different manufacturers

Name manufacturer	Number of NRLs (n=30)
BD	1
Biorad	14
BUL-BIO	1
Dade Behring	3
Denka Seiken	3
Difco	2
Imuna	1
Immunolab	1
Mast Group Ltd	2
Prolab	6
Reagensia AB	2
Remel	1
Sifin	19
Statens Serum Institute	22
Own laboratory	1

Question 8: Were the strains in the collaborative study typed in your own laboratory?

One NRL-*Salmonella* (laboratory code 30) sent 2 strains to another laboratory for serotyping and 1 NRL (labcode 10) sent all strains to another laboratory for serotyping. All other laboratories tested all strains in their own laboratory.

4.4 Questions regarding phage typing

Question 9: Does your laboratory perform phage typing of *Salmonella* Enteritidis, *S. Typhimurium* and/or of other strains?

Seven NRLs performed phage typing of *S. Typhimurium* and *S. Enteritidis* strains and one NRL performed phage typing only for *S. Enteritidis*. For routine purposes three NRLs also phage typed other strains like, *S. Hadar*, *S. Virchow*, *S. Paratyphi B* and *S. Typhi*.

Question 10: How many strains did your laboratory phage type in 2007?

The replies to question 10 are summarised in Table 9.

Table 9 Number of phage typings in 2007

Laboratory codes	Number of strains phage typed in 2007
1	2781
3	2015
4	1036
5	3111
6	396
7	4800
8	670*

* Only *S. Enteritidis* strains

5 Results

5.1 Serotyping by the NRLs-*Salmonella*

5.1.1 General

Due to problems with mailing of the parcel in November 2007, laboratory 15 received a new set of strains in week 9 of 2009. Because of logistic reasons, this laboratory performed the analyses of the strains not before week 21 of 2009, while the other participants performed the study in week 48/49 of 2008. Because of this delayed performance of the study, the results of laboratory 15 were not used for the 'group analyses'. Below only the individual results of laboratory 15 will be presented.

5.1.2 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 which were correct in Figure 4. 22 Laboratories (laboratory codes 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 18, 20, 21, 23, 24, 26, 27, 28 and 29) typed all O-antigens accurately. 21 laboratories (laboratory codes 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 18, 20, 21, 23, 24, 25, 26, 27, 29 and 30) typed all H-antigens correctly and 17 laboratories (laboratory codes 2, 3, 5, 6, 7, 8, 9, 11, 14, 18, 20, 21, 23, 24, 26, 27 and 29) identified all serovar names correctly.

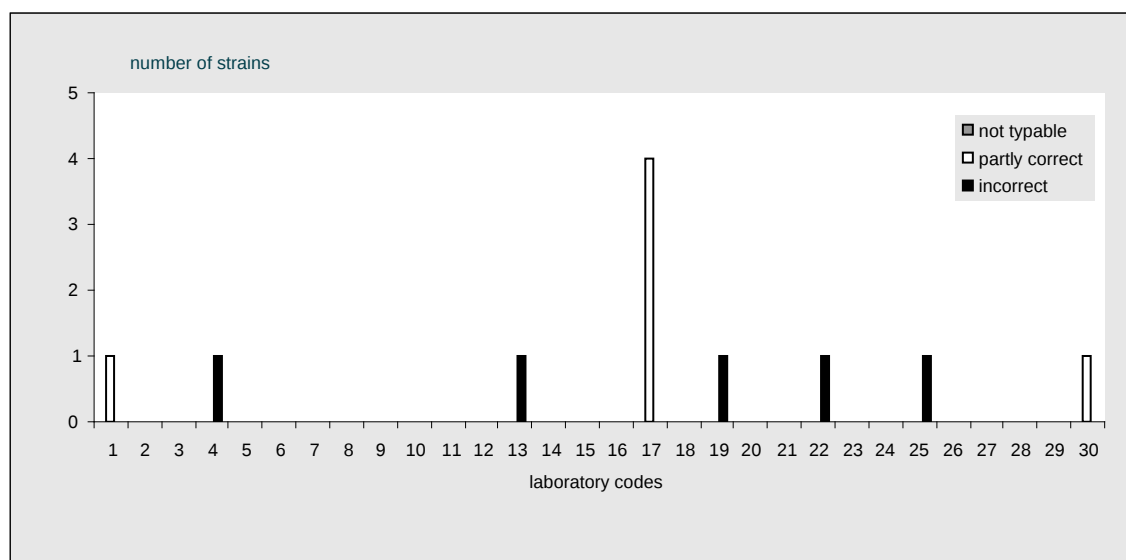


Figure 1 Evaluation of serotyping of O-antigens per NRL

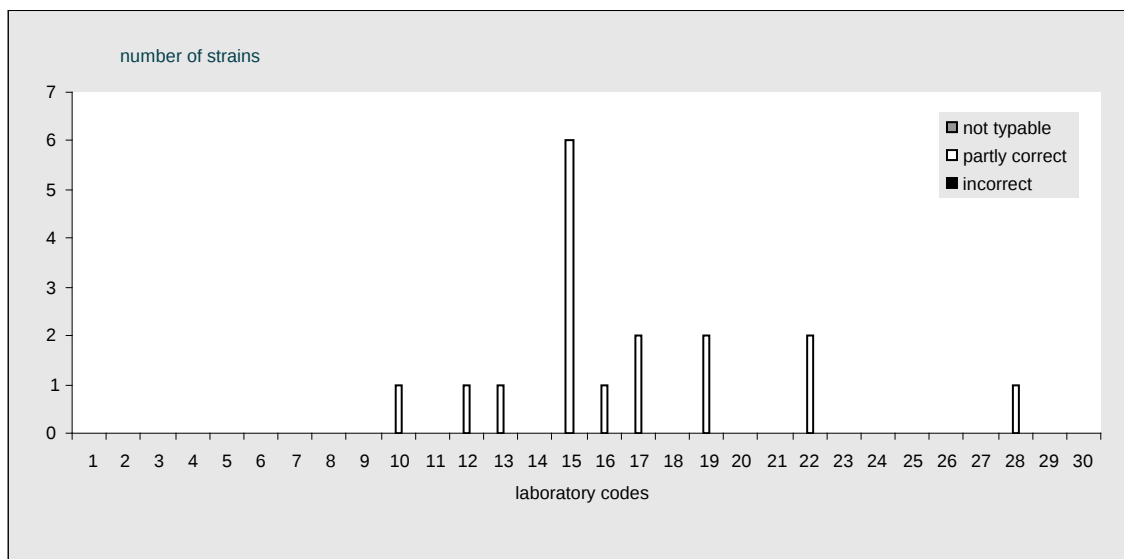


Figure 2 Evaluation of serotyping of H-antigens per NRL

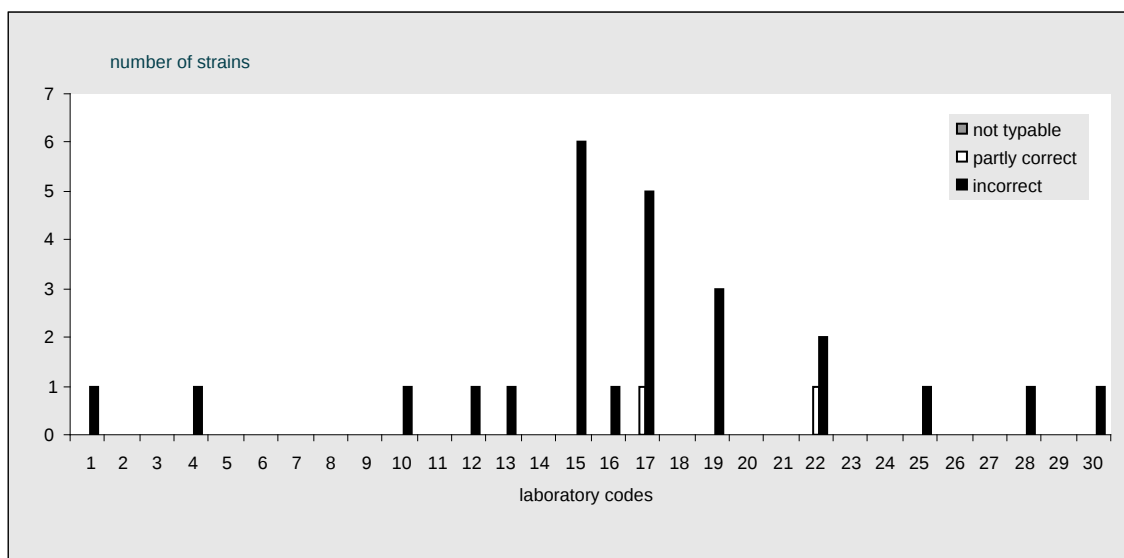


Figure 3 Evaluation of the correct serovar names per NRL

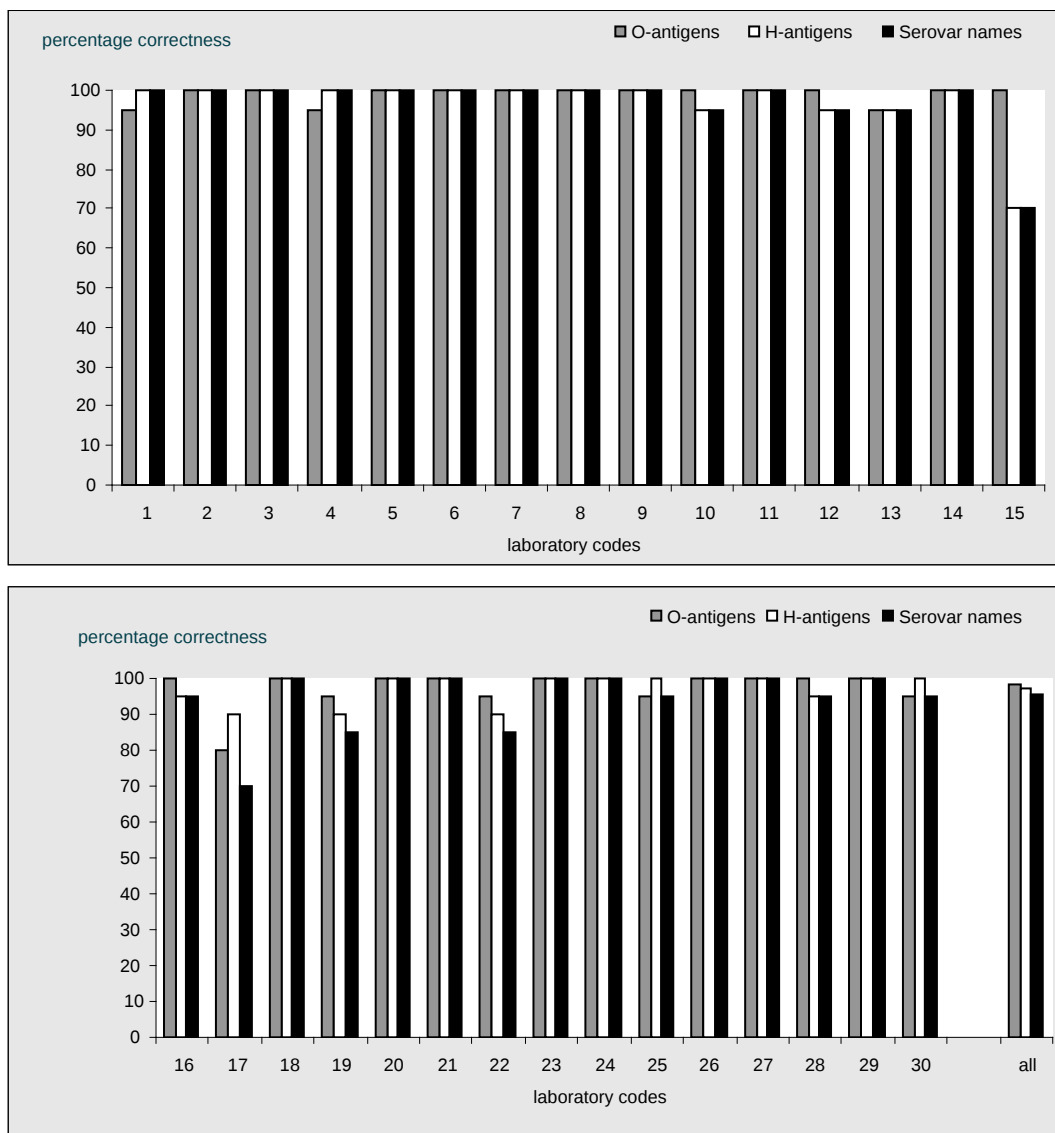


Figure 4 Achievements of the serotyping in percentages

The 29 NRLs, who performed the study in November 2008, were able to correctly type 98 % of the O- and H-antigens and 97 % of the serovar names were typed correctly.

The laboratory with labcode 3 indicated that in the vial with *S. Dublin* also *S. Virchow* could be found. The laboratory with labcode 29 only found *S. Virchow* in this vial. Since the serovar formula's differ completely (respectively 9,12 : g,p : - and 6,7 : r : 1,2) this is probably due to a mistake in the laboratory of the CRL-*Salmonella*. Therefore both *S. Dublin* and *S. Virchow* are considered correct for this vial.

For each NRL the amount of penalty points were determined using the guidelines in section 3.5.

Table 10 shows the amount of penalty points for each NRL, in the second column it is reported whether the level of good performance was achieved.

Table 10 Evaluation of serotyping results per NRL

Labcode	Penalty points	Good performance?	Labcode	Penalty points	Good performance?
1	1	Yes	16	1	Yes
2	0	Yes	17	9	No
3	0	Yes	18	0	Yes
4	1	Yes	19	3	Yes
5	0	Yes	20	0	Yes
6	0	Yes	21	0	Yes
7	0	Yes	22	6	No
8	0	Yes	23	0	Yes
9	0	Yes	24	0	Yes
10	4	No	25	1	Yes
11	0	Yes	26	0	Yes
12	1	Yes	27	0	Yes
13	1	Yes	28	1	Yes
14	0	Yes	29	0	Yes
15*	9	No	30	4	No

*: Study was performed in May 2009 instead of November 2008.

5.1.3 Serotyping results per strain

The evaluation of the detection of O- and H-antigens and identification of the serovar names per strain are shown in Table 11. The O-antigens of 12 strains were typed correctly by all participants. The H-antigens were typed correctly for 9 strains by all participating laboratories. A total correct identification by all participants was obtained for 6 strains being:

- S. Derby;
- S. Brandenburg;
- S. Give;
- S. Heidelberg;
- S. Infantis;
- S. Typhimurium.

Table 11 Evaluation of the typing of strains by the NRLs

Strains	O-antigens				H-antigens				Serovar names			
	+	nt	+/-	-	+	nt	+/-	-	+	nt	+/-	-
S. Coeln	30	0	0	0	29	0	1	0	29	0	0	1
S. Plymouth	30	0	0	0	28	0	2	0	28	0	1	1
S. Bredeney	30	0	0	0	29	0	1	0	29	0	0	1
S. Derby	30	0	0	0	30	0	0	0	30	0	0	0
S. Colindale	29	0	0	1	30	0	0	0	29	0	0	1
S. Worthington	28	0	1	1	27	0	3	0	26	0	0	4
S. Paratyphi B var. Java	28	0	0	1	29	0	1	0	28	0	0	2
S. Brandenburg	30	0	0	0	30	0	0	0	30	0	0	0
S. Blockley	29	0	1	0	30	0	0	0	29	0	0	1
S. Senftenberg	28	0	0	2	30	0	0	0	28	0	0	2
S. Hadar	28	0	2	0	29	0	1	0	27	0	0	3
S. Give	30	0	0	0	30	0	0	0	30	0	0	0
S. Mbandaka	29	0	1	0	28	0	2	0	27	0	0	3
S. Heidelberg	30	0	0	0	30	0	0	0	30	0	0	0
S. Virchow	30	0	0	0	29	0	1	0	29	0	1	0
S. Dublin*	30	0	0	0	28	0	2	0	28	0	0	2
S. Infantis	30	0	0	0	30	0	0	0	30	0	0	0
S. Enteritidis	30	0	0	0	28	0	2	0	28	0	0	2
S. Typhimurium	30	0	0	0	30	0	0	0	30	0	0	0
S. Kottbus	29	0	1	0	29	0	1	0	28	0	0	2

+ = correct; nt = not typable ; +/- = partly correct ; - = incorrect;

*: A few samples of S16 (S. Dublin) may have been contaminated with S. Virchow, both strains are considered correct.

The figures indicate the number of laboratories finding the relevant results (total number of laboratories = 30)

Most problems occurred with S. Worthington. But also some NRLs had problems typing S. Hadar, S. Mbandaka, S. Plymouth, S. Paratyphi B var. Java, S. Senftenberg, S. Dublin, S. Enteritidis, and S. Kottbus. The characterisations of strains that caused problems in serotyping by the NRLs are shown in Table 12. The empty cells in the table indicate that strains were typed correctly by the laboratories mentioned.

Results found per serotype and per laboratory are given in Appendix 5.

Table 12 Identifications per strain that caused most problems in serotyping by the NRLs

Laboratory code	S. Senftenberg (S10) 1, 3, 19 : g, s, t : -	S. Mbandaka (S13) 6, 7, 14 : z ₁₀ : e, n, z ₁₅	S. Enteritidis (S18) 1, 9, 12 : g, m : -
1		S. Glostrup 6, 8 : z ₁₀ : e, n, z ₁₅	
4	S. Newyork 13, 22 : g, s, t : -		
10			S. Gueuletapee 9 : g, m, s : -
12		S. Mikawasima 6, 7, 14 : y : e, n, z ₁₅	
15		S. Jerusalem 7 : z ₁₀ : l, w	
22	S. Kingston 4 : s, t : -		S. Blegdam 9 : m, q : -
Laboratory code	S. Worthington (S6) 1, 13, 23 : z : l, w	S. Hadar (S11) 6, 8 : z ₁₀ : e, n, x	S. Dublin (S16) 1, 9, 12 : g, p : -
13	S. Poona 22 : z : l, 6		
15	S. enterica subsp. salamae II 13 : l, w : e, n, x	S. Sandow 6, 8 : f, g : e, n, z ₁₅	
17	S. Carno 1, 3, 19 : z : l, w	S. Istanbul 8 : z ₁₀ : e, n, x	S. Rostock 1, 9, 12 : g, p, u
19	S. Ivrysurseine 1, 13, 23 : z : z ₆		
28			S. Rostock 9 : g, p, u
30		S. Djugu 7; 6, 14, 24 : z ₁₀ : E, x	
Laboratory code	S. Plymouth (S2) 9, 46 : d : z ₆	S. Paratyphi B var. Java (S7) 1, 4, [5], 12 : b : 1, 2	S. Kottbus (S20) 6, 8 : e, h : 1, 5
15	S. Olten 9, 46 : d : e, n, z ₁₅	S. enterica subsp. salamae II 4, 5 : b : -	S. Newport 6, 8 : e, h : 1, 2
17	Not typable 9, 46 : d : 1, z ₆		S. Ferruch 8 : e, h : 1, 5
19		S. Kalina 3, 10 : b : 1, 2	

5.1.4 Follow-up

Five NRLs did not achieve the level of good performance (Table 10). As laboratory 15 performed the study very late (week 21, 2009), it was not possible to include this laboratory in the follow-up study which was organised in week 11-13, 2009. The other 4 NRLs (labcodes 10, 17, 22 and 30) received 10 extra strains in week 10, 2009. The evaluation of the detection of O- and H-antigens and identification of the strains per laboratory of the follow-up study are shown in Figure 5.

The results of laboratory 15 were discussed individually and a training was offered.

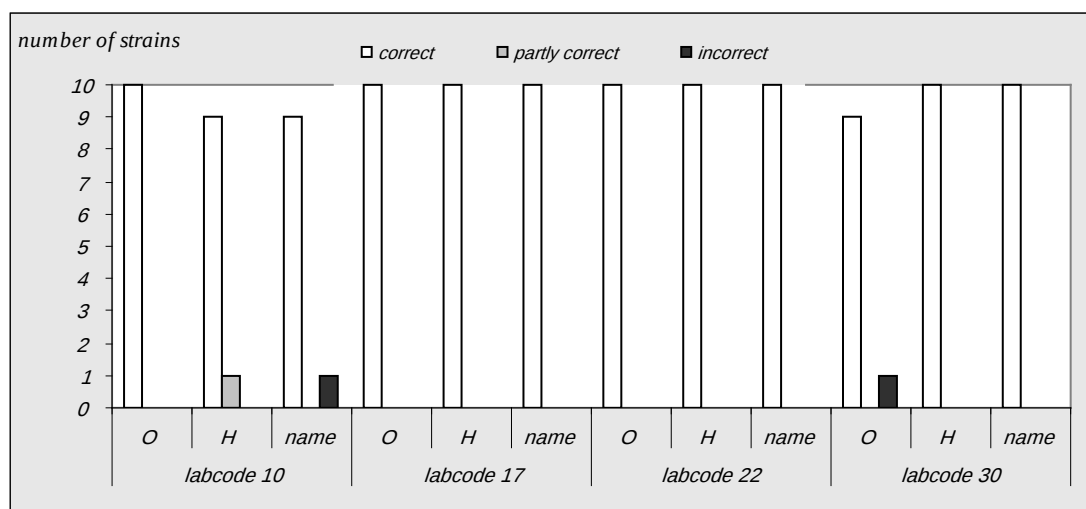


Figure 5 Evaluation of serotyping O- and H-antigens and of the serovar names by the NRLs during the follow-up study

Results found per serotype and per laboratory are given in Table 13. For each NRL again the amount of penalty points were determined using the guidelines in section 3.6. Table 14 shows the amount of penalty points for each NRL, in the second column it is reported whether the level of good performance is achieved. The four NRLs all achieved the level of good performance in this follow-up study.

Table 13 Serotyping results per *Salmonella* strain and per NRL, found during the follow-up study

Laboratory code	S1	S2	S3	S4	S5
CRL	Enteritidis	Senftenberg	Hadar	Dublin	Typhimurium
10	Enteritidis	Senftenberg	Hadar	Dublin	Typhimurium
17	Enteritidis	Senftenberg	Hadar	Dublin	Typhimurium
22	Enteritidis	Senftenberg	Hadar	Dublin	Typhimurium
30	Enteritidis	Senftenberg	Hadar	Dublin	Typhimurium

Laboratory code	S6	S7	S8	S9	S10
CRL	Canstatt	Wernigerode	Kedougou	Blockley	Virchow
10	Kouka	Wernigerode	Kedougou	Blockley	Virchow
17	Cannstatt	Wernigerode	Kedougou	Blockley	Virchow
22	Cannstatt	Wernigerode	Kedougou	Blockley	Virchow
30	Cannstatt	Wernigerode	Kedougou	Blockley	Virchow

Table 14 Evaluation of serotyping results per NRL for the follow up

Labcode	Penalty points	Good performance?
10	1	Yes
17	0	Yes
22	0	Yes
30	0	Yes

5.2 Phage typing results of the NRLs-*Salmonella*

The phage typing results of the NRLs were evaluated per strains and by laboratory and are shown in Tables 15 and 16. Six laboratories performed phage typing for both *Salmonella* Enteritidis and *Salmonella* Typhimurium. One laboratory performed phage typing for *S. Enteritidis* only. Six laboratories (laboratory codes 1, 3, 4, 5, 6 and 7) assigned the correct phage type for all 10 of the *S. Enteritidis* (SE) strains. The laboratory with labcode 8 assigned the wrong phage type to 3 of the strains (PT 8, 1 and 60) and 1 strain could not be typed because the readings were not typical. Four laboratories (labcodes 1, 4, 5 and 7) assigned the correct phage type for all 10 of the *S. Typhimurium* (STM) strains. 2 laboratories assigned the correct phage type to 9 of the *S. Typhimurium* strains. They both assigned the wrong phage type, DT104H, to strain M13 (being PT 12a). Separate notations per phage and per laboratory are given in Appendix 6. The achievements in percentage correctness are presented in Figure 6. Overall 94 % of the *Salmonella* Enteritidis strains and 97 % of the *Salmonella* Typhimurium strains were phage typed correctly.

Table 15 Results of *Salmonella* Enteritidis phage typing

		Phage typing found per NRL						
Labcodes		1	3	4	5	6	7	8
Strain	PT							
E1	47	47	47	47	47	47	47	47
E2	6	6	6	6	6	6	6	6
E3	8	8	8	8	8	8	8	28
E4	59	59	59	59	59	59	59	-
E5	4	4	4	4	4	4	4	4
E6	1	1	1	1	1	1	1	4
E7	14b	14b	14b	14b	14b	14b	14b	14b
E8	1b	1b	1b	1b	1b	1b	1b	1b
E9	6c	6c	6c	6c	6c	6c	6c	6c
E10	60	60	60	60	60	60	60	20

PT = phage type, grey cells = deviating results, -: no result

Table 16 Results of *Salmonella* Typhimurium phage typing

		Phage typing found per NRL					
Labcodes		1	3	4	5	6	7
Strain	PT						
M11	2	2	2	2	2	2	2
M12	208	208	208	208	208	208	208
M13	12a	12a	104H	12a	12a	104H	12a
M14	136	136	136	136	136	136	136
M15	193	193	193	193	193	193	193
M16	12	12	12	12	12	12	12
M17	36	36	36	36	36	36	36
M18	18	18	18	18	18	18	18
M19	U311	U311	U311	U311	U311	U311	U311
M20	104	104	104	104	104	104	104

PT = phage type, grey cells = deviating results

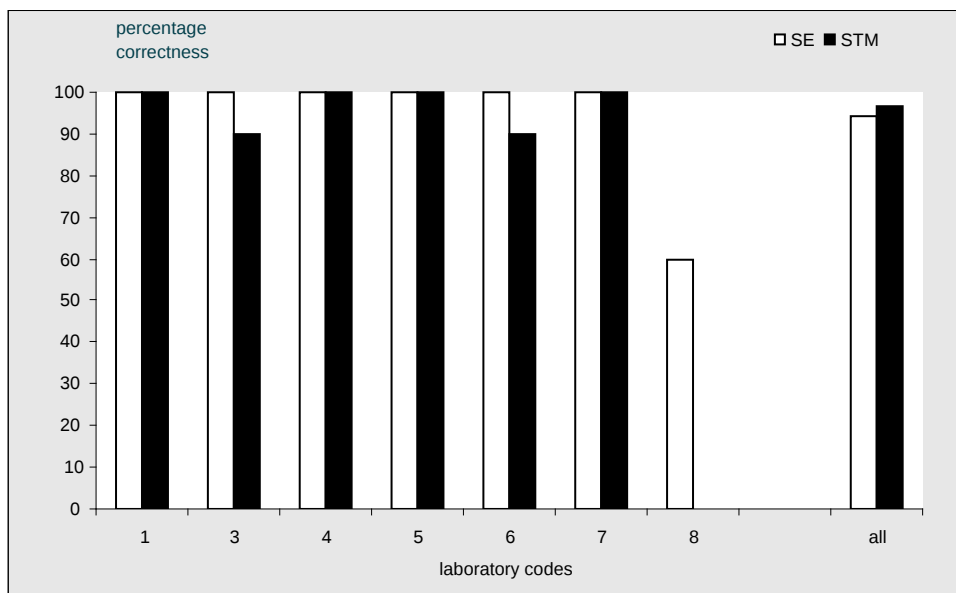


Figure 6 Achievements of the phage typing in percentages correctness

6 Discussion

Serotyping

In previous interlaboratory comparison studies on serotyping, the NRLs showed a lower percentage of correctness when typing the H-antigens than when typing the O-antigens. For example in the study of 2007, 98 % of the O-antigens were typed correctly and 96 % of the H-antigens. When the results of laboratory 15 are not taken into account (because of the delayed performance of the study), the present study showed that the NRLs were able to correctly type 98 % of the O-antigens as well as of the H-antigens. Also an improvement in assigning the correct serovar name was seen. In 2007, 95 % of the serovar names were correct, while in the present study this was 97 %.

When evaluating the results of the participants, mistakes in typing 5 *Salmonella* serovars (Enteritidis, Typhimurium, Hadar, Infantis and Virchow) are more severely judged than for the other *Salmonella* serovars. This ‘*Salmonella* - top 5’ is indicated in European legislation and it is important that the laboratories are well able to type these serovars correctly. None of the NRLs had problems with correctly serotyping *S. Typhimurium* and *S. Infantis*. One mistake was made with typing *S. Virchow* and two or three mistakes were made when serotyping respectively *S. Enteritidis* or *S. Hadar*. In the follow-up study these strains were typed correctly by all NRLs, showing that they are indeed able to correctly type the ‘*Salmonella* - top 5’.

Due to problems with mailing of the parcel to laboratory 15, followed by logistic problems at the NRL, this laboratory performed the study very late. The results did not meet the criteria of good performance, but it was not possible anymore to organise a follow-up study. Through direct contact some advices were given for improvement of the serotyping. Laboratory 15 used these advices to perform a repeated serotyping on the ‘problem’ strains. This showed better results. It was agreed to wait for the results of the next interlaboratory comparison study on typing of 2009 to decide on the need for a training.

Phage typing

Ten strains of *S. Enteritidis* and 10 strains of *S. Typhimurium* were selected by the *Salmonella* Reference Unit of the Health Protection Agency in London. The NRLs participating in the phage typing were also supplied with 2 new phages for this study, *S. Enteritidis* Phage 17 and *S. Typhimurium* Additional Phage 10 var 3. An updated version of the *S. Enteritidis* phage typing scheme was also provided for this study. This version of the scheme has 96 phage patterns for *S. Enteritidis*.

All ten of the *S. Enteritidis* strains were correctly typed by six of the seven NRLs. The seventh NRL incorrectly typed four of the *S. Enteritidis* strains: E3 (PT 8), E4 (PT 59), E6 (PT 1) and E10 (PT 60). The results this laboratory obtained for the strain E8 (PT 1b) were correct. As this phage type reacts with all the phages, it suggests that the phages were correctly diluted before use. The incorrect results may be due to incorrect reading of the phage reactions or due to some errors in the technique used for the phage typing.

The ten strains of *S. Enteritidis* in this study included three new phage types: PT 6c, PT 47 and PT 60. Six of the laboratories correctly typed all of these new phage types.

Four of the NRLs correctly phage typed all ten of the *S. Typhimurium* strains. The remaining two laboratories correctly phage typed nine of the strains. Both of these laboratories incorrectly phage typed strain M13 (PT 12a). They both typed it as 104H. Laboratory 3 did not observe a reaction with phages 21 and 35. These phages did not give any problems with the other strains which suggest a

misreading of the phage reactions of this specific strain. Laboratory 6 did not observe any phage reactions with phages 21 and 27. This could have been due to misreading of the phage reactions, especially phage 21 which gives a low reading on PT 12a.

All the laboratories correctly phage typed strain M19 (U311) which is identified by only reacting with the new phage Additional 10 var 3.

Overall 94 % of the *S. Enteritidis* strains were phage typed correctly. This is lower than the results of the 2007 study when 98 % of the *S. Enteritidis* strains were typed correctly. However, the low correctness of phage typing was caused by only one laboratory. When the results of this laboratory were not taken into account, 100 % of the *S. Enteritidis* strains were phage typed correctly. The results for *S. Typhimurium* were better than the 2007 study. In 2007 91 % of the *S. Typhimurium* strains were correctly typed and in this study 97 % were correctly phage typed.

7 Conclusions

Serotyping

When the results of laboratory 15 are not taken into account, the following can be concluded:

- 98 % of the O-antigens were typed correctly.
- 98 % of the H-antigens were typed correctly.
- 97 % of the serovar names were correct.
- Serotyping of *Salmonella* Worthington was causing most problems.
- Serotyping of the H-antigens is improved when compared to former studies.
- 4 NRLs did not achieve the level of good performance.
- Follow-up: 3/4 NRLs typed all 10 extra strains correctly, 1 NRL typed 9/10 strains correctly.
- In the follow-up all NRLs achieved the level of good performance.

Phage typing

- 94 % of the *S. Enteritidis* strains were typed correctly. When the results of laboratory 8 were not taken into account this percentage was 100 %.
- 97 % of the *S. Typhimurium* strains typed correctly.
- 6/10 *S. Enteritidis* strains were correctly typed by all participating laboratories.
- 9/10 *S. Typhimurium* strains were correctly typed by all participating laboratories.
- Only 1 *S. Typhimurium* strain caused a problem: M13 (PT 12a), which was incorrectly typed by 2 laboratories.

References

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

http://www.pasteur.fr/sante/clre/cadrecnr/salmoms/WKLM_2007.pdf (visited 13-04-2010).

Mooijman, K.A. (2007) The twelfth CRL-*Salmonella* workshop; 7 and 8 May 2007, Bilthoven, the Netherlands. Report no.: 330604006. National Institute for Public Health and the Environment, Bilthoven, the Netherlands.

Regulation (EC) No 882/2004 of the European Parliament and of the council of 29 April 2004 on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules.

List of abbreviations

BGA	Brilliant Green Agar
CRL- <i>Salmonella</i>	Community Reference Laboratory for <i>Salmonella</i>
EFTA	European Free Trade Association
HPA	Health Protection Agency
LGP	Laboratory of Gastrointestinal Pathogens
NI	Not indicated
NRLs- <i>Salmonella</i>	National Reference Laboratories for <i>Salmonella</i>
Nt	Not typable
PT	Phage Type
RDNC	Reacts with phages but does not confirm to a recognized pattern
RIVM	National Institute for Public Health and the Environment
SE	<i>Salmonella</i> Enteritidis
STM	<i>Salmonella</i> Typhimurium
UK	United Kingdom
XLD	Xylose Lysine Desoxycholate

Appendix 1 Protocol

Protocol of the thirteenth interlaboratory comparison study (XIII, 2008) on serotyping and phage typing of *salmonella* strains organised by CRL-*Salmonella*

Introduction

The Community Reference Laboratory (CRL) for *Salmonella* organises the thirteenth interlaboratory comparison study on the typing of *Salmonella* strains amongst the National Reference Laboratories for *Salmonella* (NRLs-*Salmonella*).

The main objective of this typing study is to test the performance of the participating laboratories for serotyping and phage typing of *Salmonella* spp.

The study will take place in week 48 (starting on 24 November 2008) or 1 week earlier or later. All data will be reported in the test report, sent to the CRL-*Salmonella* and will be used for analysis. The data on phage typing will be sent to CRL-*Salmonella* and to Elizabeth de Pinna, Health Protection Agency (HPA), London, UK.

Transportation of the *Salmonella* strains to the NRLs-*Salmonella*.

CRL-*Salmonella* will mail both the serotyping and phage typing strains in one parcel. The strains will be sent as diagnostic specimens with a door-to-door courier to your laboratory.

Serotyping

A total number of 20 *Salmonella* strains (numbered S-1 till S-20), supplied by the CRL-*Salmonella*, have to be serotyped. The method routinely performed in your laboratory can be used in this study. Each laboratory is allowed to send strains for serotyping to another reference laboratory in their country, if this is part of the normal routine procedure.

In the test report of this study 2 extra tables are added. Please indicate the reactions for every strain-antiserum combination used. This supplies the CRL-*Salmonella* with more information in case of any incorrect results.

The results will be evaluated by the CRL-*Salmonella*. Definite conclusions can only be based on agglutination with mono-specific antisera. Otherwise it is better to identify the strains by giving the antigenic formula as far as detected. The evaluation of the serotyping results will be performed according to Table A1.1.

Table A1.1 Guidelines for evaluation

Results	Evaluation	Abbreviation
Auto agglutination or Incomplete set of antisera (outside range of antisera)	Not typable	NT
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	-

Phage typing

The laboratories will receive a parcel containing 20 *Salmonella* cultures for phage typing:

- 10 strains of *S. Enteritidis* numbered E1-E10;
- 10 strains of *S. Typhimurium* numbered M11-M20.

The evaluation of the phage typing results will be done in collaboration with Elizabeth de Pinna, HPA, London, UK.

If you have questions or remarks about the interlaboratory comparison study, please contact:

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3720 BA Bilthoven
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fax. number: +31-30-2744434
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If you have questions or remarks on the phage typing please contact:

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Public Health Laboratory Service, Laboratory of Gastrointestinal Pathogens
61 Colindale Avenue, London NW9 5HT
tel. number: + 44-20-8327 6136
fax number: + 44-20-8905 9929
e-mail: Elizabeth.DePinna@HPA.org.uk

Timetable of the 13th interlaboratory comparison study (2008) on serotyping and phage typing of *Salmonella* spp.

Week	Date	Topic
45	3-7 November	Mailing of the protocol and test report 2008.
47	17-21 November	Mailing of the parcels to the participants as diagnostic specimens by door-to-door courier service. After arrival at the laboratory the strains need to be subcultured and stored until the performance of the typing. If you did not receive the parcel at 21 November, do contact the CRL immediately.
48	24-28 November	Starting with the identification of the strains.
50	8-12 December	Send the completed test report by e-mail to CRL- <i>Salmonella</i> . If the test report is e-mailed to the CRL it is not longer necessary to send the original test report as well, unless it is not legible (to be indicated by CRL- <i>Salmonella</i>). Deadline: 12 December 2008
51	15-19 December and onwards	Data input at CRL- <i>Salmonella</i> and sending these data by CRL to NRLs by e-mail for checking. Checking the results by the participants (NRLs) and they will inform CRL whether their results are correct. If CRL does not receive a reaction within one week after receipt of this e-mail the CRL will consider the results as correct.

Appendix 2 Test report

Test report

Follow-up interlaboratory comparison study on typing of *Salmonella* strains 2008

Laboratory code	
Name contact person	
Email address contact person	
Name of laboratory	
Name department and/or institute	
Address	
Country	
Is your laboratory accredited/certified and according to which system?	Serotyping: Yes/No System:..... Phage typing: Yes/No System:.....
If you are not yet accredited/certified are you planning to do so in the near future?	Yes/No System:.....

Please write your remarks and comments on the last page of the test report!!

GENERAL QUESTIONS**Shipment of serotyping and phage typing strains**

Was your parcel damaged at arrival?	☐ NO ☐ YES
Date of receipt at your laboratory	

Subculturing

Medium used for subculturing the strains	Name..... Manufacturer.....
--	--------------------------------

REMARKS CONCERNING THE TABLES FOR SEROTYPING

Two extra tables are added to this test report, to give the CRL-*Salmonella* more information about the (O- and H-) antisera used. On the bottom of the tables there is space left to fill in other antisera than mentioned in the table.

Please mention the manufacturer of the antisera used in the column next to the antisera. For every combination of strain and antisera you indicate if there was agglutination (+) or not (-). If the cell remains empty this indicates that the agglutination was not determined for the specific combination of antisera and strain.

QUESTIONS SEROTYPING	
What was the frequency of serotyping of <i>Salmonella</i> at your laboratory in 2007?	☐ Daily ☐ Once a week ☐ Twice a week ☐ Thrice a week ☐ Weekly ☐ Monthly
How many <i>Salmonella</i> strains did your laboratory serotype in 2007?	Number of strains:.....
How many of these typings considered a rough strain?	Number of rough strains:.....
What kind of sera do you use?	☐ Prepared in own laboratory ☐ Commercial sera Manufacturer(s):
The strains in this collaborative study were serotyped by:	☐ Own laboratory, Strain..... ☐ Other laboratory, namely..... Strains:.....

		Strains									
O-antisera	Manufacturer	1	2	3	4	5	6	7	8	9	10
Group B											
1, 4, 12, 27											
1, 4, 5, 12											
4, 5, 12											
4, 5, 27											
4, 5											
4											
5											
Group C											
7, 8											
6, 7, 8											
6, 7											
6 ₁ , 6 ₂ , 7											
6, 8											
8, 20											
6 ₁											
6											
7											
8											
Group D											
9											
9, 12											
1, 9, 12											
12											
9, 46											
9, (46)											
46											
Group E											
1, 3, 10, 15, 19, 34											
3, 10, 15, 19, 34											
(3), (15), 34											
3, 10, 15											
3, 10											
3, 15											
10											
15											
1, 3, 19											
19											

		Strains									
O-antisera	Manufacturer	11	12	13	14	15	16	17	18	19	20
Group B											
1, 4, 12, 27											
1, 4, 5, 12											
4, 5, 12											
4, 5, 27											
4, 5											
4											
5											
Group C											
7, 8											
6, 7, 8											
6, 7											
6 ₁ , 6 ₂ , 7											
6, 8											
8, 20											
6 ₁											
6											
7											
8											
Group D											
9											
9, 12											
1, 9, 12											
12											
9, 46											
9, (46)											
46											
Group E											
1, 3, 10, 15, 19, 34											
3, 10, 15, 19, 34											
(3), (15), 34											
3, 10, 15											
3, 10											
3, 15											
10											
15											
1, 3, 19											
19											

		Strains									
H-antisera	Manufacturer	1	2	3	4	5	6	7	8	9	10
b											
d											
E (complex)											
e, h											
e, n											
e, n, x											
e, n, z ₁₅											
h											
x											
x (z ₁₆)											
z ₁₅											
G (complex)											
g, p											
g, m											
f											
m											
s											
q											
t											
q, s, t, p, u											
i											
k											
L (complex)											
l, v											
l, w											
v											
w											
r											
y											
z											
z ₁₀											
1 (complex)											
2											
5											
6											
7											

		Strains									
H-antisera	Manufacturer	11	12	13	14	15	16	17	18	19	20
b											
d											
E (complex)											
e, h											
e, n											
e, n, x											
e, n, z ₁₅											
h											
x											
x (z ₁₆)											
z ₁₅											
G (complex)											
g, p											
g, m											
f											
m											
s											
q											
t											
q, s, t, p, u											
i											
k											
L (complex)											
l, v											
l, w											
v											
w											
r											
y											
z											
z ₁₀											
1 (complex)											
2											
5											
6											
7											

TEST RESULTS SEROTYPING

Labcode	
Starting date of serotyping	
Finishing date of serotyping	

Strain no.	O-antigens detected	H-antigens detected	Serovar
S-1			
S-2			
S-3			
S-4			
S-5			
S-6			
S-7			
S-8			
S-9			
S-10			
S-11			
S-12			
S-13			
S-14			
S-15			
S-16			
S-17			
S-18			
S-19			
S-20			

QUESTIONS PHAGE TYPING

Does your laboratory perform phage typing of the following strains?	☐ <i>Salmonella</i> Typhimurium ☐ <i>Salmonella</i> Enteritidis ☐ Other(s):
Which typing system is used for:	☐ <i>Salmonella</i> Typhimurium ☐ <i>Salmonella</i> Enteritidis
How many strains did your laboratory phage type in 2006?	Number of strains.....

TEST RESULTS PHAGETYPING

Labcode	
Starting date of typing	
Finishing date of typing	

QA number	Phage type	Phages reactions at Routine Test Dilution (<i>S. Enteritidis</i>)																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
E1																		
E2																		
E3																		
E4																		
E5																		
E6																		
E7																		
E8																		
E9																		
E10																		

TEST RESULTS PHAGETYPING

Labcode	
Starting date of phage typing	
Finishing date of phage typing	

QA number	Phage type	Phages at Routine Test Dilution (<i>S. Typhimurium</i>)																	
		1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
M11																			
M12																			
M13																			
M14																			
M15																			
M16																			
M17																			
M18																			
M19																			
M20																			

QA number	Phage type	Phages at Routine Test Dilution (<i>S. Typhimurium</i>)												Additional phages						
		20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var 2	10 var 3	18
M11																				
M12																				
M13																				
M14																				
M15																				
M16																				
M17																				
M18																				
M19																				
M20																				

O*: O pooled

(<)CL: clear lysis

(<)OL: opaque lysis

SCL: semi confluent lysis

<< : Merging plaques towards semi-confluent lysis

REMARKS AND COMMENTS

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Name of person(s) carrying out the typing	
Date and signature	

Name of person in charge	
Date and signature	

Appendix 3 Protocol Follow-up

Protocol of the follow-up of the twelfth interlaboratory comparison study (XIII, 2008) on serotyping of *Salmonella* strains organised by CRL-*Salmonella*

Introduction

In December 2008 the Community Reference Laboratory (CRL)-*Salmonella* has organised the thirteenth interlaboratory comparison study on the typing of *Salmonella* strains amongst the National Reference Laboratories for *Salmonella* (NRLs-*Salmonella*).

Six NRLs did not achieve the level of Good Performance for serotyping in this study, therefore this follow-up was planned in which these NRLs have to serotype 10 strains.

The performance of the study will take place in *week 10 (starting on 2 March 2009)* or one week earlier or later. All data will be reported in the test report, sent by e-mail to the CRL-*Salmonella* and will be used for analysis.

Transportation of the *Salmonella* strains to the NRLs-*Salmonella*.

CRL-*Salmonella* will mail to the NRLs the parcels as diagnostic specimens with a door-to-door courier to your laboratory.

1 Serotyping

A total number of 10 *Salmonella* strains (numbered N-1 till N-10), supplied by the CRL-*Salmonella*, have to be serotyped. The method routinely performed in your laboratory can be used in this study. Each laboratory is allowed to send strains for serotyping to another reference laboratory in their country, if this is part of the normal routine procedure.

In the test report of this study two extra tables are added. Please indicate the reactions for every strain-antiserum combination used. This supplies the CRL-*Salmonella* with more information in case of any incorrect results.

The results will be evaluated by the CRL-*Salmonella*. Definite conclusions can only be based on agglutination with mono-specific antisera. Otherwise it is better to identify the strains by giving the antigenic formula as far as detected. The evaluation of the serotyping results will be performed according to Table A3.1.

Table A3.1 Guidelines for evaluation

Results	Evaluation	Abbreviation
Auto agglutination or Incomplete set of antisera (outside range of antisera)	Not typable	NT
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	-

If you have questions or remarks about the interlaboratory comparison study, please contact:

Petra Berk
P.O. Box 1
3720 BA Bilthoven
tel. number: +31-30-2744284
fax. number: +31-30-2744434
e-mail: petra.berk@rivm.nl

Timetable of the follow-up of the 13th interlaboratory comparison study (2008) on serotyping of *Salmonella* spp.

Week	Date	Topic
7	9 – 13 February	Mailing of the protocol and test report
10	2 – 6 March	Mailing of the parcels to the participants as diagnostic specimens by door-to-door courier service. After arrival at the laboratory the strains need to be subcultured and stored until the performance of the typing. If you did not receive the parcel at 6 March, do contact the CRL immediately.
11 - 13	9 – 27 March	Identification of the strains.
13	Deadline: 27 March 2009	Send the completed test report by email to CRL- <i>Salmonella</i> . If the test report is e-mailed to the CRL it is not longer necessary to send the original test report as well.
14	30 March – 3 April	Data input at CRL- <i>Salmonella</i> and sending these data by CRL to NRLs by email for checking. Checking the results by the participants and they will inform CRL whether their results are correct. If CRL does not receive a reaction within one week after receipt of this email the CRL will consider the results as correct.

Appendix 4 Test report Follow-up

TEST REPORT

Follow-up interlaboratory comparison study on typing of *Salmonella* strains 2008

Laboratory code	
Name contact person	
Name of laboratory	
Name department and/or institute	
Address	
Country	
Is your laboratory accredited/certified and according to which system?	Serotyping: Yes/No System:..... Phage typing: Yes/No System:.....
If you are not yet accredited/certified are you planning to do so in the near future?	Yes/No System:.....

Please write your remarks and comments on the last page of the test report!!

GENERAL QUESTIONS

Shipment of serotyping strains	
Was your parcel damaged at arrival?	☐ NO ☐ YES
Date of receipt at your laboratory	

Shipment of phage typing strains	
Was your parcel damaged at arrival?	☐ NO ☐ YES
Date of receipt at your laboratory	

Subculturing

Medium used for subculturing the strains	Name..... Manufacturer.....
--	--------------------------------

QUESTIONS SEROTYPING

What kind of sera do you use?	☐ Prepared in own laboratory ☐ Commercial sera Manufacturer(s):
The strains in this collaborative study were serotyped by:	☐ Own laboratory, Strain..... ☐ Other laboratory, namely..... Strains:.....

REMARKS CONCERNING THE TABLES ON THE FOLLOWING PAGES

Two extra tables are added to this test report, to give the CRL-*Salmonella* more information about the (O- and H-) antisera used. On the bottom of the tables there is space left to fill in other antisera than mentioned in the table.

Please mention the manufacturer of the antisera used in the column next to the antisera. For every combination of strain and antisera you indicate if there was agglutination (+) or not (-). If the cell remains empty this indicates that the agglutination was not determined for the specific combination of antisera and strain.

		Strains									
O-antisera	Manufacturer	1	2	3	4	5	6	7	8	9	10
Group B											
1, 4, 12, 27											
1, 4, 5, 12											
4, 5, 12											
4, 5, 27											
4, 5											
4											
5											
Group C											
7, 8											
6, 7, 8											
6, 7											
6 ₁ , 6 ₂ , 7											
6, 8											
8, 20											
6 ₁											
6											
7											
8											
Group D											
9											
9, 12											
1, 9, 12											
12											
9, 46											
9, (46)											
46											
Group E											
1, 3, 10, 15, 19, 34											
3, 10, 15, 19, 34											
(3), (15), 34											
3, 10, 15											
3, 10											
3, 15											
10											
15											
1, 3, 19											
19											
Other O-antisera											

H-antisera	Manufacturer	Strains									
		1	2	3	4	5	6	7	8	9	10
b											
d											
E (complex)											
e, h											
e, n											
e, n, x											
e, n, z ₁₅											
h											
x											
x (z ₁₆)											
z ₁₅											
G (complex)											
g, p											
g, m											
f											
m											
s											
q											
t											
q, s, t, p, u											
i											
k											
L (complex)											
l, v											
l, w											
v											
w											
r											
y											
z											
z ₁₀											
1 (complex)											
2											
5											
6											
7											
Other H-antisera											

TEST RESULTS SEROTYPING

Labcode	
Starting date of serotyping	
Finishing date of serotyping	

Strain no.	O-antigens detected	H-antigens detected	Serovar
N-1			
N-2			
N-3			
N-4			
N-5			
N-6			
N-7			
N-8			
N-9			
N-10			

REMARKS AND COMMENTS

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Name of person(s) carrying out the typing	
Date and signature	

Name of person in charge	
Date and signature	

Appendix 5 Test results of serotyping per strain for all NRLs

Labcode	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
CRL	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
1	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
2	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
3	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
4	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Newyork
5	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
6	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
7	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
8	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
9	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
10	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
11	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
12	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
13	Coeln	Plymouth	Bredeney	Derby	Colindale	Poona	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
14	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
15	Coeln	Olten	Bredeney	Derby	Colindale	S. enterica subsp. salamae II	S. enterica subsp. salamae II	Brandenburg	Blockley	Senftenberg

Labcode	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
CRL	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
16	Coeln	Plymouth	Indiana	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
17	Coeln	NT	Bredeney	Derby	Colindale	Carno	Paratyphi B var Java	Brandenburg	Haardt	Senftenberg
18	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
19	Kamoru	Plymouth	Bredeney	Derby	Colindale	Ivrysurseine	Kalina	Brandenburg	Blockley	Senftenberg
20	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
21	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
22	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Kingston
23	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
24	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
25	Coeln	Plymouth	Bredeney	Derby	Elisabethville	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
26	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
27	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
28	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
29	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg
30	Coeln	Plymouth	Bredeney	Derby	Colindale	Worthington	Paratyphi B var Java	Brandenburg	Blockley	Senftenberg

Labcode	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
CRL	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
1	Hadar	Give	Glostrup	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
2	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
3	Hadar	Give	Mbandaka	Heidelberg	Virchow	Virchow/Dublin*	Infantis	Enteritidis	Typhimurium	Kottbus
4	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
5	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
6	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
7	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
8	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
9	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
10	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Gueuletapee	Typhimurium	Kottbus
11	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
12	Hadar	Give	Mikawasima	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
13	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
14	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
15	Sadow	Give	Jerusalem	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Newport

Labcode	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
CRL	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
16	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
17	Istanbul	Give	Mbandaka	Heidelberg	Virchow	Rostock	Infantis	Enteritidis	Typhimurium	Ferruch
18	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
19	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
20	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
21	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
22	Hadar	Give	Mbandaka	Heidelberg	O6,7 : r : -	Dublin	Infantis	Blegdam	Typhimurium	Kottbus
23	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
24	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
25	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
26	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
27	Hadar	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus
28	Hadar	Give	Mbandaka	Heidelberg	Virchow	Rostock	Infantis	Enteritidis	Typhimurium	Kottbus
29	Hadar	Give	Mbandaka	Heidelberg	Virchow	Virchow*	Infantis	Enteritidis	Typhimurium	Kottbus
30	Djugu	Give	Mbandaka	Heidelberg	Virchow	Dublin	Infantis	Enteritidis	Typhimurium	Kottbus

Grey cells = deviating results

*: A few samples of S16 (S. Dublin) may have been contaminated with S. Virchow; both strains are considered correct

Appendix 6 Test results of phage typing per strain for all NRLs

Strain E1		Phages reactions at routine test dilution (S. Enteritidis)																
labcode	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
HPA	47	-	SCL	-	-	-	<OL	-	-	-	-	-	-	-	CL	-	-	-
1	47	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	OL	-	-	-
3	47	-	+	-	-	-	+	-	-	-	-	-	-	-	<CL	-	-	-
4	47	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	CL	-	-	-
5	47	-	+++	-	-	-	<OL	-	-	-	-	-	-	-	<CL	-	-	2
6	47	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	OL	-	-	-
7	47	-	+++	-	-	-	<SCL	-	-	-	-	-	-	-	<OL	-	-	-
8	47	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	OL	-	-	-

Strain E2		Phages reactions at routine test dilution (S. Enteritidis)																
labcode	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
HPA	6	-	SCL	-	OL	-	<OL	-	OL	<OL	OL	-	-	-	-	-	-	<OL
1	6	-	CL	-	CL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	OL
3	6	-	+	-	<SCL	-	+	-	<OL	<OL	OL	-	-	-	-	-	-	OL
4	6	-	SCL	-	OL	-	SCL	-	<OL	<OL	OL	-	-	-	-	-	-	<OL
5	6	-	SCL	-	SCL	-	<OL	-	<OL	SCL	<OL	-	-	-	-	-	-	<OL
6	6	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	<OL
7	6	-	+++	-	SCL	-	SCL	-	OL	OL●	OL	-	-	-	-	-	-	<OL
8	6	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	<OL

Strain E3		Phages reactions at routine test dilution (S. Enteritidis)																
labcode	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
HPA	8	-	-	<SCL	<OL	CL	<OL	SCL	OL	<OL	OL	SCL	CL	-	-	-	-	<OL
1	8	-	-	SCL	SCL	CL	SCL	SCL	CL	OL	OL	SCL	OL	-	-	-	-	OL
3	8	-	-	<SCL	<SCL	CL	±	<CL	OL	<OL	OL	++	CL	-	-	-	-	<OL
4	8	-	-	+	<OL	SCL	SCL	+	<OL	OL	OL	++	SCL	-	-	-	-	<OL
5	8	-	-	+	SCL	<CL	<OL	±	<OL	SCL	<OL	+	<CL	-	-	-	-	SCL
6	8	-	-	<SCL	SCL	CL	SCL	<CL	OL	OL	OL	<SCL	CL	-	-	-	-	<OL
7	8	-	-	<SCL	<OL	CL	<SCL	SCL	<OL	OL●	OL	<SCL	CL	-	-	-	-	<OL
8	28	-	-	++	SCL	SCL	SCL	-	OL	OL	OL	+	SCL	-	-	-	-	OL

Strain E4		Phages reactions at routine test dilution (S. Enteritidis)																
labcode	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
HPA	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
1	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL
3	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
4	59	-	-	±	-	-	-	-	-	±	-	-	-	-	-	-	-	<OL
5	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
6	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
7	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain E5		Phages reactions at routine test dilution (S. Enteritidis)																
labcode	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
HPA	4	-	SCL	CL	OL	CL	<OL	CL	OL	OL	OL	CL	CL	CL	-	-	-	<OL
1	4	-	CL	CL	SCL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	-	-	-	OL
3	4	-	< SCL	CL	<SCL	CL	+	CL	<OL	<OL	OL	CL	CL	CL	-	-	-	<OL
4	4	-	SCL	SCL	OL	CL	SCL	CL.	<OL	<OL	OL	CL.	CL	CL.	-	-	-	<OL
5	4	-	+++	CL	SCL	CL	OL	CL	OL	<OL	OL	CL	CL	CL	-	-	-	<OL
6	4	-	SCL	CL	SCL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	-	-	-	<OL
7	4	-	SCL	<CL	OL	CL	SCL	CL	OL	<OL	OL	<CL	CL	CL	-	-	-	<OL
8	4	-	SCL	CL	SCL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	-	-	-	OL

Strain E6		Phages reactions at routine test dilution (S. Enteritidis)																
labcode	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
HPA	1	OL	SCL	CL	OL	CL	<OL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	SCL
1	1	OL	SCL	OL	OL	OL	SCL	OL	OL	OL	OL	CL	CL	CL	CL	-	-	OL
3	1	OL	<u>++</u>	CL	<u>++</u>	CL	<u>+</u>	CL	<OL	<OL	OL	CL	CL	CL	<CL	-	-	<OL
4	1	OL	SCL	CL	<OL	<CL	SCL	CL	<OL	<OL	<OL	CL	CL	CL	CL	-	-	<OL
5	1	<OL	++	CL	++	<CL	<OL	<CL	<OL	SCL	<OL	<CL	<CL	<CL	<CL	-	-	SCL
6	1	OL	SCL	CL	<OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	SCL	-	-	<OL
7	1	OL	<SCL	CL	<OL	CL	SCL	CL	<OL	<OL	OL	<CL	CL	CL	CL	-	-	<OL
8	4	-	SCL	CL	SCL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	-	-	-	OL

Strain E7		Phages reactions at routine test dilution (S. Enteritidis)																
labcode	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
HPA	14b	-	-	-	±	-	SCL	-	-	±	-	-	-	-	-	-	-	OL
1	14b	-	-	-	±	-	SCL	-	-	-	-	-	-	-	-	-	-	OL
3	14b	-	-	-	1	-	±	-	-	4	-	-	-	-	-	-	-	<OL
4	14b	-	-	-	±	-	SCL	-	-	±	-	-	-	-	-	-	-	<OL
5	14b	-	-	-	2	-	<OL	-	-	±	-	-	-	-	-	-	-	<OL
6	14b	-	-	-	-	-	SCL	-	-	±	-	-	-	-	-	-	-	<OL
7	14b	-	-	-	±	-	SCL	-	-	±	-	-	-	-	-	-	-	<OL
8	14b	-	-	-	±	-	SCL	-	-	-	-	-	-	-	-	-	-	OL

Strain E8		Phages reactions at routine test dilution (S. Enteritidis)																
labcode	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
HPA	1b	OL	SCL	CL	OL	CL	<OL	<CL	OL	<OL	<OL	CL	CL	CL	CL	SCL	CL	<OL
1	1b	OL	SCL	OL	OL	CL	SCL	CL	OL	OL	SCL	CL	CL	CL	CL	SCL	OL	OL
3	1b	<OL	++	CL	++	CL	+	CL	SCL	<OL	<OL	<CL	CL	CL	<CL	<CL	<CL	<OL
4	1b	OL	SCL	CL	<OL	CL	SCL	CL	+++	<OL	<OL	CL	CL	CL	CL	<OL	OL	<OL
5	1b	<OL	SCL	CL	SCL	CL	<OL	<CL	<OL	SCL	<CL	<CL	CL	<CL	<CL	-	<CL	<OL
6	1b	OL	SCL	CL	OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	SCL	++	CL	<OL
7	1b	OL	SCL	CL	OL	CL	SCL	CL	SCL	<OL	<OL	<CL	CL	CL	CL	SCL	SCL	<OL
8	1b	OL	SCL	CL	OL	CL	SCL	CL	OL	<OL	OL	CL	CL	CL	CL	OL	OL	OL

Strain E9		Phages reactions at routine test dilution (S. Enteritidis)																
labcode	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
HPA	6c	-	SCL	-	SCL	-	<OL	-	SCL	<OL	<OL	-	-	-	-	-	CL	<OL
1	6c	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	CL	OL
3	6c	-	±	-	+	-	±	-	++	SCL	SCL	-	-	-	-	-	<CL	<OL
4	6c	-	OL	-	<OL	-	SCL	-	<OL	<OL	OL	-	-	-	-	-	SCL	<OL
5	6c	-	++	-	++	-	<CL	-	<OL	++	SCL	-	-	-	4	-	<CL	SCL
6	6c	-	SCL	-	SCL	-	SCL	-	++	OL	++	-	-	-	-	±	SCL	<OL
7	6c	-	SCL	-	<OL	-	<SCL	-	++	SCL	+++	-	-	-	-	-	<OL	<OL
8	6c	-	SCL	-	SCL	-	SCL	-	OL	<OL	OL	-	-	-	-	+	SCL	OL

Strain E10		Phages reactions at routine test dilution (S. Enteritidis)																
labcode	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
HPA	60	OL	-	CL	-	CL	SCL	-	OL	-	OL	-	CL	CL	CL	-	-	-
1	60	OL	-	CL	-	CL	SCL	-	OL	3	OL	-	CL	CL	CL	-	-	-
3	60	OL	-	CL	-	CL	+	-	OL	-	OL	-	CL	CL	<CL	-	-	-
4	60	OL	-	SCL	-	CL	SCL	-	<OL	-	OL	-	CL	<CL	CL	-	-	-
5	60	OL	-	OL	-	CL	<CL	-	OL	-	<OL	-	CL	CL	CL	-	-	-
6	60	OL	-	CL	-	CL	SCL	-	OL	-	SCL	-	CL	CL	CL	-	-	-
7	60	OL	-	CL	-	CL	+++	-	SCL	-	OL●	±	CL	CL	OL	-	-	-
8	20	OL	-	CL	-	CL	-	+	OL	-	OL	+	CL	-	CL	SCL	CL	-

Strain M11		Phages at routine test dilution (S. Typhimurium)																	
Labcode	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	2	-	CL	CL	OL	CL	CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	CL
1	2	-	SCL	CL	CL	CL	CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	CL
3	2	-	<CL	<CL	OL	<CL	CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	<CL
4	2	-	SCL	CL	OL	SCL	CL	-	-	SCL	SCL	CL	CL	CL	CL	CL	SCL	-	SCL
5	2	-	<CL	CL	OL	CL	CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	CL
6	2	-	CL	CL	CL	CL	CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	CL
7	2	-	SCL	<CL	CL	CL	<CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	<CL

Strain M11		Phages at routine test dilution (S. Typhimurium)												Additional phages						
Labcode	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var2	10 var3	18
HPA	2	CL	OL	OL	CL	CL	CL	<CL	CL	-	CL	CL	OL	+++	+	++	OL	OL	SCL	OL
1	2	SCL	CL	SCL	CL	CL	SCL	SCL	SCL	-	CL	SCL	OL	±	±	±	OL	OL	OL	OL
3	2	<CL	CL	<CL	CL	CL	<CL	CL	CL	-	CL	SCL	<OL	3	4	-	<OL	<OL	<OL	CL
4	2	SCL	SCL	SCL	SCL	CL	SCL	SCL	SCL	-	CL	<SCL	OL							
5	2	SCL	<OL	<OL	CL	CL	CL	CL	CL	-	CL	CL	OL	+	+	+	OL	OL	<CL	CL
6	2	<CL	CL	<CL	<CL	<CL	CL	CL	CL	-	CL	CL	CL	++	++	++	OL	OL	<OL	OL
7	2	CL	<CL	CL	CL	CL	<CL	CL	CL	3	CL	<CL	CL	++	+++	++	OL	OL	SCL	CL

Strain M12		Phages at routine test dilution (S. Typhimurium)																	
Labcode	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain M12		Phages at routine test dilution (S. Typhimurium)												Additional phages						
Labcode	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var2	10 var3	18
HPA	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	+++	+	OL
1	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	OL
3	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	++	++	+
4	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	<OL	++
5	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	<OL	SCL	++
6	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	<OL	OL
7	208	-	-	-	-	-	-	-	-	-	-	-	-	-	±	-	OL●	SCL	<SCL	+++

Strain M13		Phages at routine test dilution (S. Typhimurium)																	
Labcode	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	12a	-	-	-	-	-	-	-	±	-	-	OL	OL	-	-	-	-	<CL	-
1	12a	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	CL	-
3	104H	-	-	-	-	-	-	-	1	-	-	CL	CL	-	-	-	-	CL	-
4	12a	-	-	-	-	-	-	-	-	-	-	SCL	CL	-	-	-	-	SCL	-
5	12a	-	-	-	-	-	-	-	-	-	-	<CL	CL	-	-	-	-	<CL	-
6	104H	-	-	-	-	-	-	-	-	-	-	SCL	CL	-	-	-	-	SCL	-
7	12a	-	-	-	-	-	-	-	1	-	-	<CL	CL	-	-	-	-	CL	-

Strain M13		Phages at routine test dilution (S. Typhimurium)												Additional phages						
Labcode	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var2	10 var3	18
HPA	12a	-	±	-	-	-	-	-	++	-	-	-	OL	++	+	++	OL	OL	++	+
1	12a	-	+	-	-	-	-	-	SCL	-	-	-	OL	±	±	±	OL	OL	OL	OL
3	104H	-	-	-	-	-	-	-	±	-	-	-	-	1	4	-4	SCL	SCL	SCL	4
4	12a	-	±	-	-	-	-	-	+	-	-	-	<OL							
5	12a	-	±	-	-	-	-	-	±	-	-	-	++	±	±	±	SCL	OL	SCL	+
6	104H	-	-	-	-	-	-	-	-	-	-	-	SCL	-	-	-	OL	OL	<OL	OL
7	12a	-	±	-	-	-	-	-	<OL	-	-	-	OL	++	+++	++	OL	<OL	SCL	SCL

Strain M14		Phages at routine test dilution (S. Typhimurium)																	
Labcode	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	136	-	-	-	OL	CL	CL	-	-	-	CL	CL	CL	-	CL	CL	-	-	CL
1	136	-	-	-	OL	OL	OL	-	-	-	CL	CL	CL	-	CL	CL	-	-	CL
3	136	-	-	-	OL	CL	CL	-	-	-	CL	CL	CL	-	CL	CL	-	-	CL
4	136	-	-	-	OL	<OL	OL	-	-	-	<OL	<CL	CL	-	OL	OL	-	-	OL
5	136	-	-	-	OL	CL	CL	-	-	-	CL	<CL	CL	-	CL	CL	-	-	CL
6	136	-	-	-	OL	SCL	CL	-	-	-	SCL	SCL	SCL	-	CL	CL	-	-	CL
7	136	-	-	-	OL	<OL	<OL	-	-	-	CL	<CL	CL	-	SCL	CL	-	-	SCL

Strain M14		Phages at routine test dilution (S. Typhimurium)												Additional phages						
Labcode	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var2	10 var3	18
HPA	136	+	-	-	-	-	OL	-	-	-	-	-	-	-	-	-	SCL	SCL	++	-
1	136	+	-	-	-	-	SCL	-	-	-	-	-	-	-	-	±	OL	OL	OL	-
3	136	4	-	-	-	-	<CL	-	-	-	-	-	-	-	-	-	+	++	++	-
4	136	+	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-	-	-
5	136	+	-	-	-	-	CL	-	-	-	-	-	-	-	-	-	<OL	<OL	SCL	-
6	136	+	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	OL	OL	<OL	-
7	136	+	-	-	-	-	<CL	-	-	-	-	-	-	±	±	±	<OL	OL●	SCL	-

Strain M15		Phages at routine test dilution (S. Typhimurium)																	
Labcode	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain M15		Phages at routine test dilution (S. Typhimurium)												Additional phages						
Labcode	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var2	10 var3	18
HPA	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-
1	193	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	-	-	-	-
3	193	-	-	-	-	-	-	-	-	-	-	-	-	+	++	++	-	-	-	-
4	193	-	-	-	-	-	-	-	-	-	-	-	-	++	±	+	-	-	-	-
5	193	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	-	-	-	-
6	193	-	-	-	-	-	-	-	-	-	-	-	-	<SCL	<SCL	<SCL	-	-	-	-
7	193	-	-	-	-	-	-	-	-	-	-	-	-	++	SCL	SCL	-	-	-	-

Strain M16		Phages at routine test dilution (S. Typhimurium)																	
Labcode	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	12	-	-	-	-	-	-	-	-	-	-	SCL	<CL	-	-	-	-	-	-
1	12	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	-	-
3	12	-	-	-	-	-	-	-	-	-	-	<CL	<CL	-	-	-	-	-	-
4	12	-	-	-	-	-	-	-	-	-	-	SCL	CL	-	-	-	-	-	-
5	12	-	-	-	-	-	-	-	-	-	-	<OL	OL	-	-	-	-	-	-
6	12	-	-	-	-	-	-	-	-	-	-	++	+++	-	-	-	-	-	-
7	12	-	-	-	-	-	-	-	-	-	-	+	SCL	-	-	-	-	-	-

Strain M16		Phages at routine test dilution (S. Typhimurium)												Additional phages						
Labcode	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var2	10 var3	18
HPA	12	-	-	-	-	-	-	-	-	-	-	-	-	+++	++	+++	OL	OL	++	-
1	12	-	-	-	-	-	-	-	-	-	-	-	-	±	±	±	OL	OL	OL	-
3	12	-	-	-	-	-	-	-	-	-	-	-	-	++	+	++	<OL	<OL	<OL	-
4	12	-	1	-	-	-	-	-	-	-	-	-	-							
5	12	-	-	-	-	-	-	-	-	-	-	-	-	++	+	+	OL	OL	<OL	-
6	12	-	-	-	-	-	-	-	-	-	-	-	-	SCL	++	SCL	OL	OL	<OL	-
7	12	-	-	-	-	-	-	-	-	-	-	-	-	++	+++	+++	OL	OL●	SCL	-

Strain M17		Phages at routine test dilution (S. Typhimurium)																	
Labcode	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	36	CL	CL	CL	OL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
1	36	SCL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
3	36	+++	SCL	SCL	OL	CL	CL	CL	CL	CL	CL	<CL	<CL	CL	CL	CL	CL	CL	CL
4	36	<SCL	SCL	CL	CL	SCL	CL	SCL	SCL	SCL	SCL	CL	SCL	CL	CL	CL	CL	SCL	CL
5	36	<CL	<CL	CL	OL	CL	CL	<CL	<CL	<CL	CL	<CL	<CL	CL	CL	CL	CL	<CL	CL
6	36	CL	CL	CL	CL	<CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
7	36	CL●	<CL	CL	CL	CL	CL	CL	CL	<CL	<CL	+ <<	SCL	CL	<CL	CL	CL	<CL	<CL

Strain M17		Phages at routine test dilution (S. Typhimurium)												Additional phages						
Labcode	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var2	10 var3	18
HPA	36	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	+++	++	+++	OL	OL	++	OL
1	36	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	+	+	+	OL	OL	OL	OL
3	36	<CL	CL	<OL	CL	CL	<CL	CL	CL	OL	CL	SCL	<OL	+	+	+	<OL	<OL	<OL	CL
4	36	SCL	CL	OL	SCL	CL	SCL	SCL	SCL	CL	CL	<SCL	OL							
5	36	<CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	OL	++	+	++	OL	OL	<OL	CL
6	36	CL	CL	CL	CL	CL	<CL	SCL	CL	CL	CL	CL	OL	SCL	++	SCL	OL	OL	<OL	OL
7	36	CL	<CL	CL	CL	CL	<CL	CL	CL	CL	CL	CL	CL	++	+++	+++	OL	<OL	SCL	CL

Strain M18		Phages at routine test dilution (S. Typhimurium)																	
Labcode	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	18	-	-	-	-	-	-	-	-	-	<OL	-	-	-	SCL	-	<OL	SCL	SCL
1	18	-	-	-	-	-	-	-	-	-	SCL	-	-	-	OL	-	OL	SCL	OL
3	18	-	-	-	-	-	-	-	-	-	SCL	-	-	-	++	-	SCL	SCL	3
4	18	-	-	-	-	-	-	-	-	-	+++	-	-	-	<OL	-	<OL	SCL	<OL
5	18	-	-	-	-	-	-	-	-	-	SCL	-	-	-	<OL	-	++	+++	++
6	18	-	-	-	-	-	-	-	-	-	OL	-	-	-	OL	-	OL	OL	<OL
7	18	-	-	-	-	-	-	-	-	-	SCL	-	-	-	+	-	SCL	SCL	±

Strain M18		Phages at routine test dilution (S. Typhimurium)												Additional phages						
Labcode	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var2	10 var3	18
HPA	18	SCL	-	-	-	-	-	-	+	-	-	OL	+	+++	++	+++	OL	<OL	+	-
1	18	SCL	-	-	-	-	-	-	+	-	-	SCL	3	±	±	±	±	OL	OL	OL
3	18	±	-	-	-	-	-	-	1	-	-	+	-	+	+	+	++	++	<SCL	2
4	18	SCL	-	-	-	-	-	-	±	2	-	+++	±							
5	18	+	-	-	-	-	-	-	2	-	-	SCL	-	++	++	++	<OL	<CL	++	3
6	18	OL	-	-	-	-	-	-	+	-	-	SCL	+	+	+	+	OL	OL	<OL	-
7	18	<SCL	-	-	-	-	-	-	±	-	-	++ <<	-	++	++	+	<OL	SCL	<SCL	-

Strain M19		Phages at routine test dilution (S. Typhimurium)																	
Labcode	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain M19		Phages at routine test dilution (S. Typhimurium)												Additional phages						
Labcode	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var2	10 var3	18
HPA	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	-
1	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-
3	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	-
4	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	-
5	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<CL	-
6	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	-
7	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	-

Strain M20		Phages at routine test dilution (S. Typhimurium)																	
Labcode	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	104	-	-	-	-	-	-	-	-	-	-	++	SCL	-	-	-	-	++	-
1	104	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	+	-
3	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	++	-
4	104	-	-	-	-	-	-	-	-	-	-	<SCL	SCL	-	-	-	-	++	-
5	104	-	-	-	-	-	-	-	-	-	-	++	SCL	-	-	-	-	+	-
6	104	-	-	-	-	-	-	-	-	-	-	++	+++	-	-	-	-	++	-
7	104	-	-	-	-	-	-	-	-	-	-	±	SCL	-	-	-	-	++	-

Strain M20		Phages at routine test dilution (S. Typhimurium)												Additional phages						
Labcode	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var2	10 var3	18
HPA	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	+++	-
1	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
3	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<SCL	<OL	<OL	-
4	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<CL	<CL	SCL
6	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	<OL	-
7	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL●	SCL	-

- = no reaction; ± = 5-20 plaques; + = 21-40 plaques; ++ = 41-80 plaques; +++ = 81-100 plaques; scl = semi-confluent lysis; cl = confluent clear lysis; ol = confluent opaque lysis; << = merging plaques towards semi-confluent lysis.

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