National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Fifteenth EURL-Salmonella inter-laboratory comparison study (2010) on typing of Salmonella spp.

RIVM report 330604024/2011

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Colophon

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Abstract

Fifteenth EURL-*Salmonella* interlaboratory comparison study (2010) on typing of *Salmonella* spp.

The National Reference Laboratories (NRLs) of all 27 European Member States, as well as the NRLs of Croatia, Former Yugoslav Republic of Macedonia, Norway, Turkey and Switzerland performed well on the 2010 quality control test on *Salmonella* typing. Four laboratories were found to require a follow-up study on their first test but all participants obtained good scores in this follow-up study. 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 95% of the strains tested.

Since 1992, the NRLs of the EU Member States have been required to participate in annual quality control tests, which consist of interlaboratory comparison studies on *Salmonella*. Each Member State designates a specific laboratory within their national boundaries to be responsible for the detection and identification of *Salmonella* strains from animals and/or food products. These laboratories are then referred to as the National Reference Laboratories. The performance of these NRLs on *Salmonella* typing 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 on a voluntary basis. Croatia, Former Yugoslav Republic of Macedonia, Norway, Turkey and Switzerland took part in the 2010 test.

Seven NRLs not only serotyped the 20 *Salmonella* strains of the quality control test, but also subtyped 20 additional strains by phage typing. For this, the laboratories received ten strains of *Salmonella* Enteritidis and ten strains of *Salmonella* Typhimurium. These NRLs typed 98% of the *S.* Typhimurium strains correctly. Of the *S.* Enteritidis strains, 99% were phage typed correctly.

The European Union Reference Laboratory for *Salmonella* (EURL-*Salmonella)* organizes this annual interlaboratory comparison study on typing of *Salmonella* in cooperation with the Health Protection Agency in London, UK. The EURL-*Salmonella* is situated at the National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands.

Keywords:
EURL- *Salmonella*, *Salmonella* spp., serotyping, phage typing, interlaboratory comparison study

Rapport in het kort

Vijftiende EURL-*Salmonella* ringonderzoek (2010) voor de typering van *Salmonella* spp.

De Nationale Referentie Laboratoria (NRL's) van de 27 Europese lidstaten en de NRL's van Kroatië, Voormalige Joegoslavische Republiek Macedonië, Noorwegen, Turkije en Zwitserland scoorden in 2010 goed bij de kwaliteitscontrole op *Salmonella*-typering. Vier laboratoria hadden hiervoor een herkansing nodig. Uit de analyse van alle NRL's als groep bleek dat de laboratoria aan 95% van de geteste stammen de juiste naam konden geven.

Sinds 1992 zijn de NRL's van de Europese lidstaten verplicht om deel te nemen aan jaarlijkse kwaliteitstoetsen, die bestaan uit zogeheten ringonderzoeken voor *Salmonella*. Elke lidstaat wijst een laboratorium aan, het Nationale Referentie Laboratorium (NRL), dat binnen dat land verantwoordelijk is om *Salmonella* uit monsters van levensmiddelen of dieren aan te tonen en te typeren. Om te controleren of de laboratoria hun werk goed uitvoeren moeten zij onder andere 20 *Salmonella*-stammen op juiste wijze identificeren. Soms doen ook landen buiten de Europese Unie vrijwillig mee. In 2010 waren dat Kroatië, Voormalige Joegoslavische Republiek Macedonië, Noorwegen, Turkije en Zwitserland.

Van de NRL's zijn er zeven laboratoria die, naast de standaardtoets (serotypering) op *Salmonella*, preciezere typeringen uitvoeren, de zogeheten faagtyperingen. Voor deze kwaliteitstoets moeten zij twintig extra stammen met deze methode typeren. De laboratoria ontvingen hiervoor tien *Salmonella* Enteritidis-stammen en tien *Salmonella* Typhimurium-stammen. Deze NRL's typeerden 98% van de *S.* Typhimurium-stammen en 99% van de *S.* Enteritidis-stammen op de juiste wijze.

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

Trefwoorden:
EURL-*Salmonella, Salmonella* spp., serotypering, faagtypering, ringonderzoek

Contents

Summary

In November 2010, the fifteenth interlaboratory comparison study on typing of *Salmonella* was organized by the European Union Reference Laboratory for *Salmonella* (EURL-*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*) within the European Union was carried out uniformly and whether comparable results were obtained.

A total of 28 NRLs-*Salmonella* of the 27 member states of the European Union participated, as well as the NRLs of Norway, Switzerland, Croatia, Former Yugoslav Republic of Macedonia and Turkey. All 33 NRLs performed serotyping. A total of 20 strains of *Salmonella enterica* subspecies *enterica* were selected for serotyping by the EURL-*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 if this is part of their usual routine procedure.

Overall, 98% of the strains were typed correctly for the O-antigens, 95% of the strains were typed correctly for the H-antigens and 95% of the strains were correctly named by the NRLs.
At the EURL-*Salmonella* workshop in 2007, the EURL-*Salmonella* proposed a definition for Good Performance of the NRLs regarding the serotyping. Using this definition, 29 NRLs achieved this level of Good Performance. The four NRLs which did not achieve the level of Good Performance received ten additional strains for serotyping. All participating NRLs achieved the level of Good Performance in this follow-up study.

The HPA selected 20 strains for phage typing. Ten were of the *Salmonella* serovar Enteritidis (SE) and ten of the *Salmonella* serovar Typhimurium (STM). Seven of the participating NRLs-*Salmonella* also performed phage typing.
Six NRLs phage typed of both *S.* Enteritidis and *S.* Typhimurium strains. One NRL phage typed only *S.* Enteritidis strains. The phage typing results of the majority of the laboratories were good.
The seven NRLs phage typed 99% of the *Salmonella* Enteritidis strains correctly and six NRLs correctly phage typed 98% of the *Salmonella* Typhimurium strains.

1 Introduction

This report describes the fifteenth interlaboratory comparison study on the typing of *Salmonella* spp. organized by the European Union Reference Laboratory for *Salmonella* (EURL-*Salmonella*, Bilthoven, the Netherlands), in November 2010.

According to Regulation (EC) no 882/2004, it is one of the tasks of the EURL-*Salmonella* to organize 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.

A total of 33 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, as defined by the EURL-*Salmonella,* had to participate in a follow-up study in which ten additional strains were serotyped.
Seven of the NRLs-*Salmonella* performed phage typing on ten *Salmonella* Enteritidis strains and six of the NRLs-*Salmonella* performed phage typing on ten *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	Austrian Agency for Health and Food Safety (AGES) NRC *Salmonella* Graz
Belgium	Veterinary and Agrochemical Research Centre (VAR) CODA Brussels
Bulgaria	National Reference Centre of Food Safety Sofia
Croatia	Croatian Veterinary Institute Zagreb
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 Salmonella Prague
Denmark	National Food Institute, Technical University of Denmark Department of Microbiology and Risk Assessment Copenhagen
Estonia	Estonian Veterinary and Food Laboratory Diagnostic Department, Bacteriological Laboratory Tartu
Finland	Finnish Food Safety Authority EVIRA Research Department, Veterinary Bacteriology, Kuopio Laboratory Section Kuopio
Former Yugoslav Republic of Macedonia	Food Institute, Skopje
France	ANSES Laboratoire de Sécurité des Aliments Maison Alfort Cedex
Germany	Federal Institute for Risk Assessment (BFR) National Veterinary *Salmonella* Reference Laboratory Berlin
Greece	Veterinary Laboratory of Chalkis Chalkis
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

Country	Institute/City
Latvia	Institute of Food Safety, Animal Health and Environment Animal Disease Diagnostic Laboratory BIOR Riga
Lithuania	National Food and Veterinary Risk Assessment Institute Vilnius
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 Infectious Diseases and Perinatal Screening Bilthoven
Northern Ireland (UK)	Agri-Food and Biosciences Institute (AFBI) Veterinary Sciences Division, Bacteriological Department Belfast
Norway	National Veterinary Institute Section of Bacteriology Oslo
Poland	National Veterinary Research Institute Microbiological Department Pulawy
Portugal	Laboratório Nacional de Investigação Veterinária Lisbon
Romania	Institute of Diagnosis and Animal Health 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
Turkey	Etlik Central Veterinary Control and Research Institute Etlik Ankara
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 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 sending. The complete antigenic formulae, according to the most recent White-Kauffmann-Le Minor scheme (Grimont and Weill, 2007), of the 20 serovars are shown in Table 1.
Shortly after the study, information revealed that colonial form variation may occur with the expression of the O:6_1 antigen by some serogroup C_2 serovars (Hendriksen et al., 2009). For the current interlaboratory comparison study on typing it was therefore decided to consider the serovar pairs *S*. Newport/*S*. Bardo and *S*. Hadar/*S*. Istanbul not as distinct serovars.

Table 1 Antigenic formulas of the 20 Salmonella *strains according to the White-Kauffmann-LeMinor scheme used in the 15th EURL-* Salmonella *typing study*

Strain	O-antigens	H-antigens (phase 1)	H-antigens (phase 2)	Serovar
S1	1,3,19	z	l,w	Carno
S2	1,4,12,27	l,v	1,7	Bredeney
S3	13,23	b	1,6	Bracknell
S4	9,46	d	z_6	Plymouth
S5	1,3,19	d	e,n,z_{15}	Liverpool
S6	3,10	e,h	l,w	Meleagridis
S7	1,4,[5],12	e,h	e,n,x	Chester
S8	1,4,[5],12	f,g,s	-	Agona
S9	6,8	z_{10}	e,n,x	Hadar
S10	1,4,[5],12	i	1,2	Typhimurium
S11	8,20	z_{10}	z_6	Molade
S12	3,10	l,v	1,7	Give
S13	1,4,[5],12	f,g	-	Derby
S14	3,10	e,h	1,6	Anatum
S15	1,9,12	g,m	-	Enteritidis
S16	6,7,14	r	1,2	Virchow
S17	1,4,12,27	d	1,7	Schwarzengrund
S18	1,4,[5],12	i	-	1,4,[5],12:i:-
S19	6,7,14	r	1,5	Infantis
S20	1,9,12	[f],g,[t]	-	Berta

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 ten strains of *Salmonella* Typhimurium were selected. The phage reactions of the *Salmonella* Enteritidis strains used in the study are given in Table 2, the page reactions of the *Salmonella* Typhimurium strains are given in Table 3.

The explanation of the various notations in Tables 2 and 3 and the tables in Annex 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 used in the 15th EURL-*Salmonella *typing study*

		Phage reactions at Routine Test Dilution (*S.* Enteritidis)															
Strain Nr.	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
E1	55	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
E2	1b	OL	SCL	CL	OL	CL	SCL	CL	OL	OL	SCL	CL	CL	CL	SCL	OL	OL	SCL
E3	15a	-	-	++	-	CL	+++	-	OL	-	OL	-	CL	CL	-	-	-	-
E4	6a	-	SCL	-	OL	-	SCL	-	-	<OL	-	-	-	-	-	-	-	SCL
E5	13a	-	-	-	OL	-	SCL	-	OL	OL	SCL	-	-	-	-	-	-	SCL
E6	6	-	SCL	-	OL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	SCL
E7	8	-	-	SCL	<OL	CL	SCL	<CL	OL	OL	<OL	CL	CL	-	-	-	-	SCL
E8	1	OL	SCL	CL	OL	CL	SCL	CL	OL	OL	<OL	CL	CL	CL	<CL	-	-	SCL
E9	13	-	-	-	SCL	-	SCL	-	-	SCL	-	-	-	-	-	-	-	++
E10	4	-	SCL	CL	OL	CL	SCL	CL	OL	OL	<OL	CL	CL	CL	-	-	-	SCL

Table 3 Phage reactions of the Salmonella *Typhimurium strains used in the 15th EURL-*Salmonella *typing study*

Phage reactions at Routine Test Dilution (*S.* Typhimurium)																			
Strain nr.	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
T1	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T2	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T3	46a	-	SCL	OL	OL	OL	OL	-	-	OL	OL	-	-	OL	OL	OL	OL	-	OL
T4	7	-	-	-	-	-	-	OL	-	-	-	-	-	-	-	-	-	CL	-
T5	15a	-	-	-	-	-	-	-	-	-	OL	CL	CL	-	OL	-	OL	-	SCL
T6	24	-	-	SCL	-	-	-	-	-	-	-	-	-	CL	-	-	-	-	-
T7	15	-	-	-	-	-	-	-	-	-	OL	CL	CL	-	OL	-	OL	CL	++
T8	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T9	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	+++	-
T10	36	CL	CL	CL	OL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL

Phage reactions at Routine Test Dilution (*S.* Typhimurium)														Additional phages						
Strain nr.	**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**
T1	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	±	-
T2	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	OL
T3	46a	SCL	OL	OL	OL	OL	OL	OL	OL	OL	OL	OL	OL	+	+	+	-	-	-	OL
T4	7	+	-	-	-	-	-	-	-	-	-	OL	-	+	+	+	SCL	OL	OL	-
T5	15a	SCL	-	-	-	-	-	-	-	-	-	OL	-	+	+	+	OL	OL	OL	+
T6	24	-	-	-	-	CL	-	CL	-	-	-	-	-	+	+	+	SCL	OL	OL	±
T7	15	SCL	-	-	-	-	-	-	-	-	-	OL	-	±	±	±	OL	OL	OL	±
T8	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-
T9	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
T10	36	CL	OL	OL	CL	CL	CL	CL	CL	OL	CL	CL	OL	++	++	++	OL	OL	OL	CL

3.3 Laboratory codes

The NRLs-*Salmonella* were assigned a laboratory code 1-33, which differed from the previous typing studies.

3.4 Protocol and test report

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

3.5 Transport

All samples were packed and transported as Biological Substance Category B (UN 3373) and transported by door-to-door courier service. The parcels containing the strains for serotyping and phage typing were sent by EURL-*Salmonella* in week 45, 2010.

3.6 Guidelines for evaluation

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

Table 4 Evaluation of serotyping results

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	-

At the EURL-*Salmonella* workshop in Bilthoven in May 2007 (Mooijman, 2007), the EURL-*Salmonella* made a proposal for the level of 'Good Performance' 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* serovars (as indicated in EU legislation) and all other strains:

- 4 penalty points: Incorrect typing of *S.* Enteritidis, *S.* Typhimurium, *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 amount of penalty points is determined for each NRL-*Salmonella*. The NRL meets the criterion of 'Good Performance' if it has less than four penalty points.
A follow-up study is organized for NRLs with four penalty points or more. All NRLs of the EU Member States not meeting the criterion of 'Good Performance' have to participate in this follow-up study.

3.7 Follow-up study

The follow-up for serotyping consisted of typing an additional set of ten *Salmonella* strains. The strains for the follow-up study are shown in Table 5. All NRLs of the EU Member States with four penalty points or more had to participate in this follow-up study. The protocol and test report for the follow-up study can be found in Annex 3 and Annex 4, respectively.

Table 5 Antigenic formulas of the ten Salmonella *strains according to the White-Kauffmann-LeMinor scheme used in the follow-up part of the 15th EURL-* Salmonella *typing study*

Strain No.	**O-antigens**	**H-antigens**		Serovar
SF1	13,23	g,[s],t	-	Okatie
SF2	6,7,<u>14</u>	r	1,2	Virchow
SF3	6,7,<u>14</u>	z_{10}	e,n,z_{15}	Mbandaka
SF4	<u>1</u>,9,12	g,p	-	Dublin
SF5	3,{10}{15}	l,v	1,6	London
SF6	<u>1</u>,4,[5],12	i	1,2	Typhimurium
SF7	3,{10}{15}{15,34}	e,h	l,w	Meleagridis
SF8	1,4,[5],12	f,g	-	Derby
SF9	6,8	z_{10}	e,n,x	Hadar
SF10	<u>1</u>,9,12	g,m	-	Enteritidis

4 Questionnaire

4.1 General

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

4.2 General questions

Question 1: Was your parcel damaged on arrival?
All packages were received in good state and no damage occurred during transport.

Question 2: What was the date of receipt of the parcel at the laboratory?
All but four NRLs received their package in the same week as it was sent (week 45 of 2010). Those four NRLs received their package in week 46 of 2010.

Question 3: What kind of medium was used for sub-culturing the strains?
The NRLs used a variety of media from various manufacturers for the sub-culturing of the *Salmonella* strains. Non-selective nutrient agar was most commonly used.

4.3 Questions regarding serotyping

Question 4: What was the frequency of serotyping at your laboratory in 2009?
Question 5: How many strains did your laboratory (approximately) serotype in 2009?
Replies to questions 4 and 5 are summarised in Table 6.

Table 6 Frequency and number of strains serotyped in 2009

Lab code	Typing frequency	Number of strains typed in 2009	Lab code	Typing frequency	Number of strains typed in 2009
1	Daily	390	18	Daily	287
2	Daily	855	19	Daily	5900
3	Daily	1000	20	Daily	1700
4	Daily	608	21	Daily	4822
5	Daily	5796	22	Daily	3900
6	Twice a week	850	23	Weekly	100
7	Daily	5400	24	Daily	6000
8	Thrice a week	123	25	Thrice a week	200
9	Daily	600	26	Daily	1029
10	Thrice a week	300	27	Weekly	3400
11	Daily	2100	28	2 times a month	27
12	Twice a week	162	29	Daily	2689
13	Daily	292	30	Weekly	98
14	Twice a week	77	31	Daily	2200
15	Daily	1450	32	Weekly	
16	Weekly	75	33	Weekly	60
17	Daily	430			

Question 6: What kind of sera do you use (commercially available or prepared in own laboratory)?

The replies to question 6 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 were obtained	Number of NRL (n =31)
From 1 manufacturer	7
From 2 manufacturers	12
From 3 manufacturers	6
From 4 manufacturers	3
From 5 manufacturers or more	3
Preparation in own laboratory	5

*no info from 2 laboratories

Table 8 Number of laboratories using sera from different manufacturers

Name of Manufacturer	Number of NRL (n=31)
Becton Dickenson (BD)	2
Biomed	1
Biorad	14
BUL-BIO	1
Dade Behring	1
Denka Seiken	3
Difco	1
Immunilab	1
Mast Assure	2
Pro-Lab	6
Reagensia	1
Remel	1
Sifin	16
Statens Serum Institute	27
Preparation in own laboratory	5

*no info from 2 laboratories

Question 7: Were the strains in the collaborative study typed in your own laboratory?

Most laboratories tested all strains in their own laboratory. One NRL-*Salmonella* (laboratory code 15) sent a part of the strains to another laboratory for further serotyping. And one laboratory did not provide information on this question.

4.4 Questions regarding phage typing

Question 8: Does your laboratory perform phage typing of *S.* 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, two NRLs also phage typed other strains like *S.* Hadar, *S.* Virchow, *S.* Paratyphi B and *S.* Typhi.

Question 9: Which typing system is used for *S.* Enteritidis and *S.* Typhimurium?

All phage typing laboratories used the HPA/Colindale system.

Question 10: How many strains did your laboratory phage type in 2009?

The replies to question 10 are summarised in Table 9.

Table 9 Number of phage typings in 2009

Laboratory codes	Number of strains phage typed in 2009
5	200
7	3600
19	1450
21	2300
22	3000
27	500
29	1085

5 Results

5.1 Serotyping by the NRLs-*Salmonella*

5.1.1 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 that were correct in Figure 4. In this year's evaluation, strain S1 was excluded from the study, since it showed too many rough colonies.
All O-antigens were typed correctly by 29 laboratories (laboratory codes 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 25, 27, 28, 29, 30, 31 and 32). In addition, 22 laboratories (laboratory codes 1, 2, 3, 4, 5, 7, 8, 9, 10, 14, 15, 17, 18, 20, 21, 22, 24, 25, 26, 27, 29 and 31) typed all H-antigens correctly and 20 laboratories (laboratory codes 1, 2, 3, 4, 5, 7, 8, 9, 10, 14, 15, 17, 18, 20, 21, 22, 25, 27, 29 and 31) identified all serovar names correctly.
The O-antigens were typed correctly by 88% of the NRLs. This corresponds to 98% of the total amount of strains. The H-antigens were typed correctly by 67% of the NRLs, corresponding to 95% of the total amount of strains. And 61% of the NRLs gave the correct serovar names, corresponding to 95% of all strains.

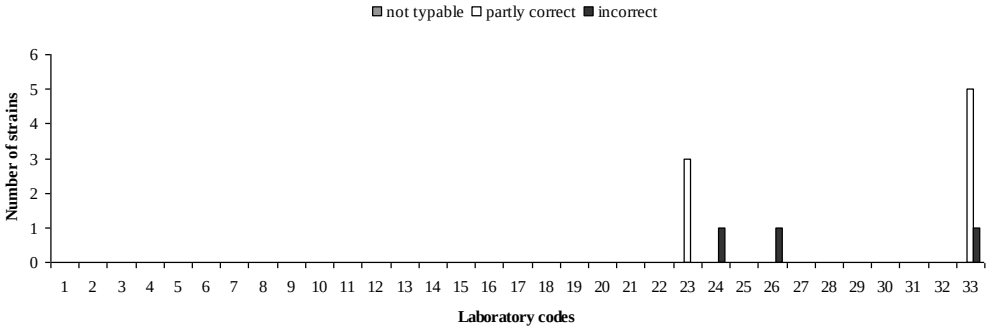

Figure 1 Evaluation of serotyping of O-antigens per NRL

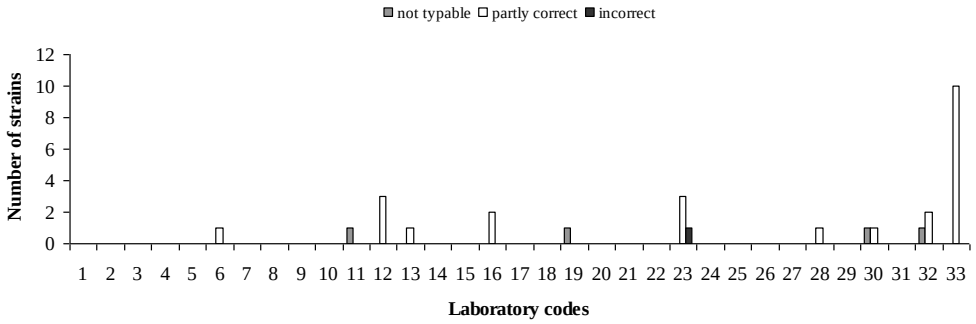

Figure 2 Evaluation of serotyping of H-antigens per NRL

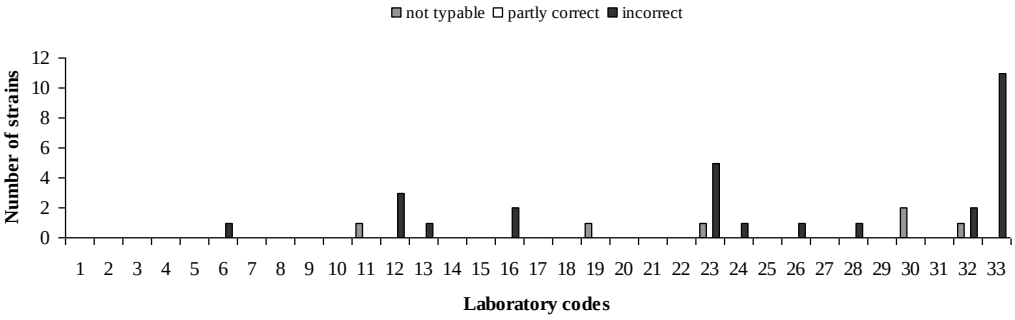

Figure 3 Evaluation of the correct serovar names per NRL

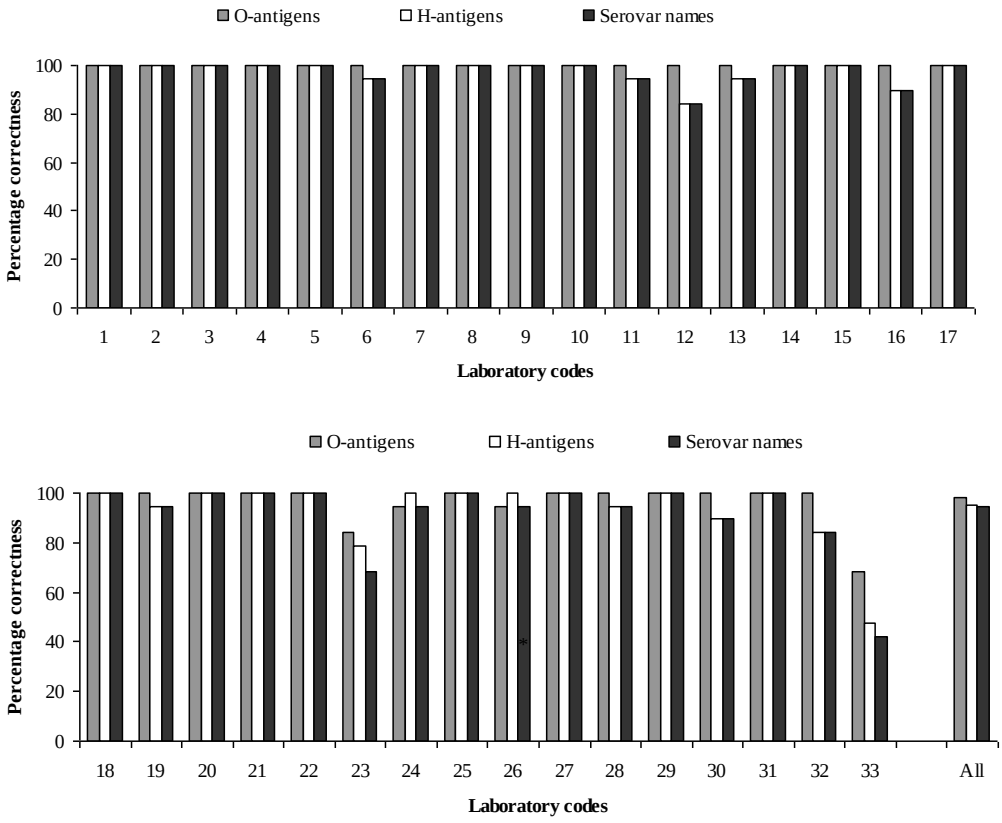

Figure 4 Achievements of the serotyping in percentages that were correct

For each NRL the amount of penalty points was determined using the guidelines in section 3.6. Table 10 shows the amount of penalty points for each NRL and whether or not the level of Good Performance was achieved. Four NRLs did not meet the level of Good Performance at this stage of the study and three of them participated in the follow-up study, serotyping an additional ten *Salmonella* strains.

Table 10 Evaluation of serotyping results per NRL (2010)

Laboratory code	Penalty points	Good Performance	Laboratory code	Penalty points	Good Performance
1	0	Yes	18	0	Yes
2	0	Yes	19	0	Yes
3	0	Yes	20	0	Yes
4	0	Yes	21	0	Yes
5	0	Yes	22	0	Yes
6	1	Yes	23	5	No
7	0	Yes	24	1	Yes
8	0	Yes	25	0	Yes
9	0	Yes	26	1	Yes
10	0	Yes	27	0	Yes
11	0	Yes	28	4	No
12	3	Yes	29	0	Yes
13	4	No	30	0	Yes
14	0	Yes	31	0	Yes
15	0	Yes	32	2	Yes
16	2	Yes	33	14	No
17	0	Yes			

5.1.2 Serotyping results per strain

Results reported per strain and per NRL are given in Annex 5. The reported serovar name for strain S18 by the NRL laboratories showed a large variation of 'Typhimurium-like' names. Therefore the reported serovar names are summarised separately in Annex 6. These results confirm the recent findings published in the EFSA opinion of September 2010. In this opinion a proposal is made to harmonise reportings of this serovar by reporting the full antigenic formula in as much detail as possible.
A completely correct identification by all participants was obtained for four strains: *S.* Agona (S8), *S.* Enteritidis (S15), *S.* Virchow (S16), and *S.* Infantis (S19).
Most problems occurred with the serovars *S.* Carno (S1), *S.* Liverpool (S5), S. Chester (S7) and S. Schwarzengrund (S17). The characterisations of strains that caused problems in serotyping by the NRLs are shown in Table 11.

Table 11 Results per strain that caused problems in serotyping by the NRLs

Strain	O-antigens	H-antigens, phase 1	H-antigens, phase 2	Serovar	Labcode
S-1	1,3,19	z	l,w	Carno	REF
S-1	15	z	l,w	Clerkenwell	3
S-1	3,10	z	l, w	Clerkenwell	4
S-1	3,10	z	l,w	Clerkenwell	10
S-1	3,10	z	w	Clerkenwell	11
S-1	3,10	z	l,v	Clerkenwell	17
S-1	3,10	z	l,w	Clerkenwell	22
S-1	3,10,15	z	L,w	Clerkenwell	25
S-1	3,10	z	l,w	Clerkenwell	26
S-1	3,10	z	l,w	Clerkenwell	31
S-1	3,10	z	1,w	Clerkenwell	32
S-1	3,15	-	l,w	3,15:-:l,w	15
S-1	1,3,19	l,v	e,n,z15	Svedi	23
S-1	1,3,19	m,t	-	Cannstatt	13
S-1	2,12	l,v	1,5	Kossen	33
S-1	3,4	z	l,w	Preston	8
S-1	1,4,12	z	l,w	Preston	24
S-1	3	z	l,w	S. species	9
S-1	O-rough	z	l,w	O-rough:z:l,w	19
S-2	1,4,12,27	l,v	1,7	Bredeney	REF
S-2	4,12	l,v	e,n,z15	Brandenburg	33
S-3	13,23	b	1,6	Bracknell	REF
S-3	13,22	b	1,6	Oudwijk	23
S-4	3,46	d	z6	Plymouth	REF
S-4	3,10	d	z6	Weybridge	24
S-4	3,12	d	z6	Zega	33
S-5	1,3,19	d	e,n,z15	Liverpool	REF
S-5	3,19	d	-	O3,19:d:-	11
S-5	1,3,19	d	1,7	Wanatah	12
S-5	1,3,19	d	?	-	32
S-5	1,3,19	d	lw	Tilburg	33
S-6	3,10	e,h	l,w	Meleagridis	REF
S-6	3,10	lw	z6	Assinie	12
S-6	3,10	l,w	z6	Assinie	32
S-6	1,3,19	l,w	1,5	Fulda	23
S-7	1,4,[5],12	e,h	e,n,x	Chester	REF
S-7	4,12	e,h	-	4,12:e,h:-	19
S-7	4,12	e,h	l,w	Chartres	16
S-7	4,12	e,h	e,n,z15	Sandiego	6
S-7	4	e,h	e,n,x,z15	Salmonella spp.	30
S-8	1,4,[5],12	f,g,s	-	Agona	REF
S-9	6,8	z10	e,n,x	Hadar	REF
S-9	6,8	z10	1,2	Zerefin	28
S-10	1,4,[5],12	i	1,2	Typhimurium	REF
S-10	4,12,27	i	l,w	Gloucester	33
S-11	8,2	z10	z6	Molade	REF
S-11	6,8	z10	z6	Wippra	23
S-11	6,8	z10	e,n,z15	Glostrup	33
S-12	3,10	l,v	1,7	Give	REF
S-12	3,10	g,t	1,5	Bloomsbury	23
S-12	3,10	l,v	e,n,z15	Ruzizi	33
S-13	1,4,[5],12	f,g	-	Derby	REF
S-13	4,5,12	f,g,t	z6, z42	Agona	16
S-13	4,5	g,s,t	e,n,x	Hato	33
S-14	3,10	e,h	1,6	Anatum	REF
S-14	3,10	e,h	1,5	Muenster	23
S-14	1,3,19	e,h	e,n,z15	Sao	33
S-15	1,3,12	g,m	-	Enteritidis	REF
S-16	6,7,14	r	1,2	Virchow	REF
S-17	1,4,12,27	d	1,7	Schwarzengrund	REF
S-17	1,4,12,27	b	1,7	Uppsala	12
S-17	1,4	-	7	Salmonella spp.	30
S-17	4,12,27	c	1,7	Altendorf	32
S-17	1,3,19	d	e,n,z15	Liverpool	33
S-18	1,4,[5],12	i	-	1,4,[5],12:i:-	REF
S-18	4,5,12	i	1,2	Typhimurium	33
S-19	6,7,14	r	1,5	Infantis	REF
S-20	1,3,12	[f],g,[t]	-	Berta	REF
S-20	3	g,m	-	Enteritidis	13
S-20	1,3,12	g,m,t	1,5	Salmonella II	23
S-20	2	g,m	-	Nitra	33

5.1.3 Follow-up study

Four NRLs did not achieve the level of Good Performance (Table 10) and were therefore included in the follow-up study. Three NRLs (labcodes 13, 23, 28) received ten additional strains for serotyping in week 13 (starting on 28 March 2011). Laboratory 33 was not able to participate in the follow-up.
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.

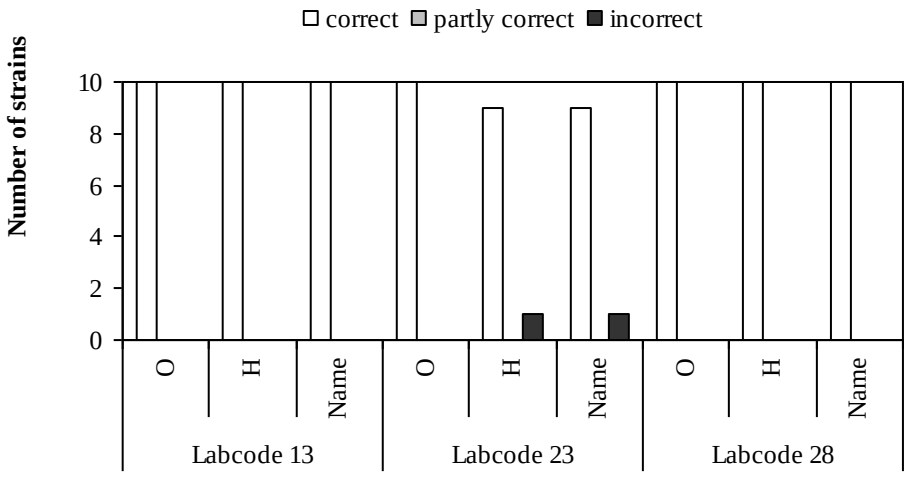

Figure 5 Evaluation of serotyping O- and H-antigens and of the serovar names by the NRLs during the follow-up study

Results found per serovar and per NRL are given in Table 12. For each NRL the amount of penalty points was determined using the guidelines in section 3.6. Table 13 shows the amount of penalty points for each NRL and whether or not the level of Good Performance was achieved. The three participating NRLs all achieved the level of Good Performance in this follow-up study.

Table 12 Serotyping results per Salmonella *strain and per NRL, in the follow-up study*

Lab	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Y	Lab	P.P
REF	Okatie	Virchow	Mbandaka	Dublin	London	Typhimurium	Meleagridis	Derby	Hadar	Enteritidis		REF	
13	Okatie	Virchow	Mbandaka	Dublin	London	Typhimurium	Meleagridis	Derby	Hadar	Enteritidis	0	13	0
23	Okatie	Virchow	Mbandaka	Dublin	London	Typhimurium	Ruzizi	Derby	Hadar	Enteritidis	1	23	1
28	Okatie	Virchow	Mbandaka	Dublin	London	Typhimurium	Meleagridis	Derby	Hadar	Enteritidis	0	28	0
X	0	0	0	0	0	0	1	0	0	0	1		

X = number of deviating laboratories per strain
Y = number of deviating strains per laboratory
P.P.= Penalty Points (see also section 3.6)

Table 13 Evaluation of serotyping results per NRL in the follow-up study

Lab code	Penalty points	Good Performance
13	0	Yes
23	1	Yes
28	0	Yes

5.2 Phage typing results of the NRLs-*Salmonella*

Six NRLs participated in the phage typing part of the study for *S*. Enteritidis and *S*. Typhimurium. One NRL phage typed only of *S*. Enteritidis strains.
The phage typing results for *S*. Enteritidis are shown in Table 14 and the results for the phage typing of *S*. Typhimurium are shown in Table 15. The percentage of strains correctly phage typed for each laboratory for both *S*. Enteritidis and *S.* Typhimurium are shown in Figure 6.
Six laboratories (laboratory codes 5, 7, 19, 22, 27 and 29) assigned the correct phage type for all ten of the *S*. Enteritidis stains. One laboratory incorrectly typed strain 9 (PT13) of the *S*. Enteritidis strains.
Five laboratories (labcodes 5, 7, 21, 22 and 29) assigned the correct phage type to all ten strains of *S.* Typhimurium and one laboratory correctly phage typed nine of the *S.* Typhimurium strains.
Five laboratories correctly phage typed all of the *S.* Enteritidis and all of the *S.* Typhimurium strains.

Overall, 99% of the *S.* Enteritidis strains and 98% of the *S.* Typhimurium strains were phage typed correctly.
Separate notations per phage and per laboratory are given in Annex 7.

Table 14 Results of Salmonella *Enteritidis phage typing*

Lab code	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
HPA	**55**	**1b**	**15a**	**6a**	**13a**	**6**	**8**	**1**	**13**	**4**
5	55	1b	15a	6a	13a	6	8	1	13	4
7	55	1b	15a	6a	13a	6	8	1	13	4
19	55	1b	15a	6a	13a	6	8	1	13	4
21	55	1b	15a	6a	13a	6	8	1	14b	4
22	55	1b	15a	6a	13a	6	8	1	13	4
27	55	1b	15a	6a	13a	6	8	1	13	4
29	55	1b	15a	6a	13a	6	8	1	13	4

Grey cells = deviating results

Table 15 Results of Salmonella *Typhimurium phage typing*

Lab code	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
HPA	**U310**	**208**	**46a**	**7**	**15a**	**24**	**15**	**193**	**104**	**36**
5	U310	208	46a	7	15A	24	15	193	104	36
7	U310	208	46a	7	15A	24	15	193	104L	36
19	U310	208	46a	59	15a	24	15	193	104	36
21	U310	208	46a	7	15A	24	15	193	104L	36
22	U310	208	46a	7	15A	24	15	193	104	36
29	U310	208	46a	7	15A	24	15	193	104L	36

Grey cells = deviating results

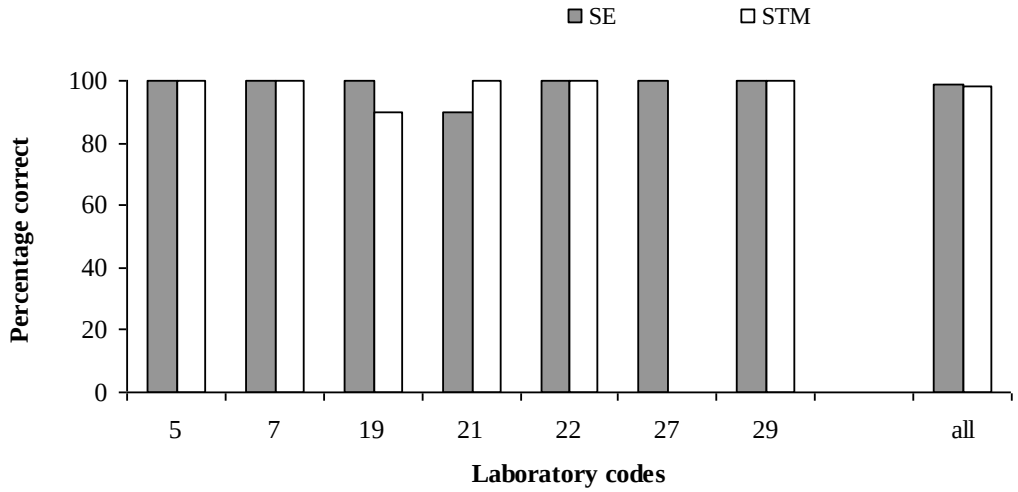

Figure 6 Percentage of strains correctly phage typed for each laboratory

6 Discussion

6.1 Serotyping

A total of 28 NRLs-*Salmonella* of the 27 member states of the European Union participated in this fifteenth interlaboratory comparison study on typing of *Salmonella*, as well as the NRLs of Croatia, Former Yugoslav Republic of Macedonia, Switzerland, Norway and Turkey. A total of 20 strains of the species *Salmonella enterica* subspecies *enterica* were sent to the participants in November 2010 for serotyping by all 33 NRLs.
Overall, 98% of the strains were typed correctly for the O-antigens, 95% of the strains were typed correctly for the H-antigens and 95% of the strains were correctly named by the NRLs.
At the EURL-*Salmonella* workshop in 2007, the EURL-*Salmonella* proposed a definition for Good Performance of the NRLs regarding the serotyping. Using this definition, 29 NRLs achieved this level of Good Performance. The four NRLs which did not achieve the level of Good Performance received ten additional strains for serotyping. Three NRLs participated in this follow-up study and achieved the level of Good Performance.

When evaluating the results of the participants, mistakes in typing 5 designated *Salmonella* serovars (Enteritidis, Typhimurium, Hadar, Infantis and Virchow) are more severely judged than the other *Salmonella* serovars. This '*Salmonella* top 5' is indicated in European legislation and it is important that the laboratories are able to type these serovars correctly. None of the NRLs had problems with correctly serotyping *S.* Enteritidis, *S.* Infantis and *S*. Virchow. One mistake was made with typing *S.* Typhimurium and one laboratory made a mistake typing *S*. Hadar.

Table 16 Details on the serotyping studies for EU-NRLs only

Study	**XII**	**XIII**	**XIV**	**XV**
Year	2007	2008	2009	2010
# participants	25	27	28	30
# strains evaluated	20	20	20	19
O-antigens correct/strains[a]	490/500 (98%)	529/540 (98%)	551/560 (98%)	568/570 (98%)
H-antigens correct/strains[a]	477/500 (95%)	528/540 (98%)	532/560 (95%)	558/570 (98%)
Strains correct/strains[a]	473/500 (95%)	521/540 (97%)	529/560 (95%)	556/570 (98%)
O-antigens correct/labs[b]	17/25 (68%)	19/27 (70%)	21/28 (75%)	28/30 (93%)
H-antigens correct/labs[b]	14/25 (56%)	18/27 (67%)	12/28 (43%)	22/30 (73%)
Strains correct/labs[b]	13/25 (52%)	14/27 (52%)	13/28 (46%)	20/30 (67%)
Total # p.p.	35	30	36	16
Total # non-Good Performance	6	3	4	2
Total # non-GP after follow-up	0	0	0	0

p.p. = penalty points, GP = Good Performance
a = Overall number of strains correct for O- or H- antigen or serovar names/ Overall number of strains analysed (# participants x # strains per laboratory)
b = Total number of laboratories scoring 100% correct on O- or H- antigens or serovar names/ Total amount of participating laboratories

Table 16 and Table 17 show an overview of the details obtained for the typing studies starting from 2007, when the system of penalty points was used for the first time. Table 16 shows results for EU-NRLs only and Table 17 shows results for all participants per study. The relatively large amount of 56 penalty points in 2009 (Table 17) was mainly due to the results of one non-EU NRL participating for the first time.

Table 17 Details on the serotyping studies for all participants

Study	**XII**	**XIII**	**XIV**	**XV**
Year	2007	2008	2009	2010
# participants	26	29	31	33
# strains evaluated	20	20	20	19
O-antigens correct/strains[a]	510/520 (98%)	568/580 (98%)	603/620 (97%)	616/627 (98%)
H-antigens correct/strains[a]	497/520 (96%)	568/580 (98%)	581/620 (94%)	598/627 (95%)
Strains correct/strains[a]	493/520 (95%)	560/580 (97%)	578/620 (93%)	593/627 (95%)
O-antigens correct/labs[b]	18/26 (69%)	22/29 (76%)	23/31 (74%)	29/33 (88%)
H-antigens correct/labs[b]	15/26 (58%)	21/29 (72%)	14/31 (45%)	22/33 (67%)
Strains correct/labs[b]	14/26 (54%)	17/29 (59%)	15/31 (48%)	20/33 (61%)
Total # p.p.	36	34	56	37
Total # non-Good Performance	6	4	5	4
Total # non-GP after follow-up	0	0	0	0

p.p. = penalty points, GP = Good Performance
a = Overall number of strains correct for O- or H- antigen or serovar names/ Overall number of strains analysed (# participants x # strains per laboratory)
b = Total number of laboratories scoring 100% correct on O- or H- antigens or serovar names/ Total amount of participating laboratories

6.2 Phage typing

Ten strains of *S.* Enteritidis and ten strains of *S.* Typhimurium were selected by the *Salmonella* Reference Unit of the Health Protection Agency in London for the phage typing part of the study.

All ten of the *S.* Enteritidis strains were correctly typed by six of the seven NRLs. One NRL incorrectly typed one of the *S.* Enteritidis strains, E9 (PT13). This laboratory obtained low reactions with phages 4 and 9 suggesting the titre of these two phage suspensions was too low.

Five of the NRLs correctly phage typed all ten of the *S*. Typhimurium strains. The remaining laboratory correctly phage typed nine of the strains and incorrectly phage typed strain T4 (DT 7) as DT 59. This laboratory obtained a low reaction with phage 18 on this strain, which resulted in the incorrect phage type being allocated to this strain. This suggests the titre of the phage suspension used was too low.

Overall, the results for this study were very good with 99% of the *S*. Enteritidis strains correctly phage typed. This is better than the results of the 2009 and the 2008 studies when 94% of the *S*. Enteritidis strains were correctly phage typed. The results for *S*. Typhimurium in this study were the same as the 2009 study. In both studies 98% of the *S*. Typhimurium strains were correctly phage typed. Results in 2010 are slightly better than two years ago. In 2008, 97% of the

S. Typhimurium strains were correctly typed and in this study 98% were correctly phage typed.

7 Conclusions

Serotyping

- 98% of the strains were typed correctly for the O-antigens.
- 95% of the strains were typed correctly for the H-antigens.
- 95% of the strains were correctly named.
- Serotyping of *S*. Carno (S1), *S.* Liverpool (S5), *S*. Chester (S7) and *S*. Schwarzengrund (S17) caused the most problems in this study.
- Four NRLs did not achieve the level of Good Performance.
- In the follow-up study, three NRLs participated and achieved the level of Good Performance.

Phage typing

- 99% of the *S.* Enteritidis strains were typed correctly.
- 98% of the *S*. Typhimurium strains were typed correctly.
- 9 out of 10 *S.* Enteritidis strains were correctly typed by all seven participating laboratories.
- 9 out of 10/10 *S*. Typhimurium strains were correctly typed by all six participating laboratories.
- One *S.* Enteritidis strain caused a problem, E9 (PT13) and was incorrectly phage typed by one laboratory.
- One *S.* Typhimurium strain caused a problem, T4 (DT7) and was incorrectly typed by one laboratory.

References

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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

DT	Definitive Type
EU	European Union
EURL-*Salmonella*	European Union Reference Laboratory for *Salmonella*
HPA	Health Protection Agency
LGP	Laboratory of Gastrointestinal Pathogens
NL	The Netherlands
NRLs-*Salmonella*	National Reference Laboratories for *Salmonella*
Nt	Not typable
p.p.	Penalty points
PT	Phage Type
REF	Reference
RIVM	National Institute for Public Health and the Environment
SE	*Salmonella* Enteritidis
STM	*Salmonella* Typhimurium
UK	United Kingdom

Annex 1 Protocol

PROTOCOL OF THE 15TH INTERLABORATORY COMPARISON STUDY (NOVEMBER 2010) ON SEROTYPING AND PHAGE TYPING OF *SALMONELLA* STRAINS, FOR THE NRL-*SALMONELLA* LABORATORIES

Introduction
The European Union Reference Laboratory (EU-RL) - *Salmonella* organises the fifteenth 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 46 (starting on 15 November 2010). The timetable can be found on the last page of this protocol.
All data have to be reported in the test report, sent to the CRL-*Salmonella* and will be used for analysis. The data on phage typing will be forwarded by CRL-*Salmonella* to the Health Protection Agency (HPA, London, United Kingdom) for further analyses.

Transportation of the *Salmonella* strains to the laboratories
The strains for the serotyping part and the phage typing part of the study will be transported in a separate parcel. The strains will be sent as Biological Substance Category B (UN 3373) with a door-to-door courier to your laboratory.

Serotyping
A total number of 20 *Salmonella* strains (coded S1 - S20) 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.

The results for each strain have to be reported with the formula for the O-antigens and H-antigens **and** the serovar names according to the White-Kauffman-le Minor scheme of 2007 (http://www.pasteur.fr/ip/portal/action/WebdriveActionEvent/oid/01s-000036-089).
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 by the Laboratory for Zoonoses and Environmental Microbiology (LZO) and the Laboratory for Infectious Diseases and Perinatal Screening (LIS) of the RIVM according to Table 1.

Table 1 Evaluation of serotyping results

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	-

Recent information revealed that colonial form variation may occur with the expression of the O:6_1 antigen by some serogroup C_2 serovars (Hendriksen et al., J Clin Microbiol 47(9): 2729-2736). Also for this study on serotyping it was decided to consider the serovar pairs concerned (e.g. as *S.* Newport/*S.* Bardo and *S.* Hadar/*S.* Istanbul in the second EQA) not as distinct serovars.

Phage typing

A total number of 20 *Salmonella* strains have to be phage typed:

- 10 strains of *S.* Enteritidis coded E1 - E10
- 10 strains of *S.* Typhimurium coded T1 - T10

The evaluation of the phage typing results will be done in collaboration with the *Salmonella* Reference Unit of the HPA.

Please record all test results in the separately provided Test Report file and return this file by e-mail to wilma.jacobs@rivm.nl on **10 December 2010 at the latest**.

A check-up by the participants of the submitted results is no longer needed when the results are sent by email in the provided file format. This will save time, ***but participants need to be sure to fill in the right results at once.***

If you have questions or remarks about this study, please contact:

Wilma Jacobs
P.O. Box 1
3720 BA Bilthoven
tel. number: +31-30-2744290
fax. number: +31-30-2744434
e-mail: wilma.jacobs@rivm.nl

If you have questions or remarks on the phage typing, please contact:

Elizabeth de Pinna
Public Health Laboratory Service, Laboratory of Enteric 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

Annex 2 Test report

TEST REPORT

THE 15TH INTERLABORATORY COMPARISON STUDY (2010) ON SEROTYPING AND PHAGE TYPING OF *SALMONELLA* STRAINS FOR THE NRL-*SALMONELLA* LABORATORIES

Laboratory code	
Name contact person	
Email address contact person	
Name of laboratory or institute	
Country	

Please enter your remarks and comments on page 12 of the test report.

GENERAL QUESTIONS

Shipment of the strains	
Was your parcel damaged at arrival?	
Date of receipt at your laboratory:	

Sub-culturing	
Medium used for sub-culturing the strains	Name: Manufacturer:

REMARKS CONCERNING THE ADDITIONAL TABLES FOR SEROTYPING

Two **optional** tables are included this test report, to give the RIVM more information about the antisera used. The tables on pages 4 and 5 concern reactions obtained with O-antisera and the tables on pages 6 and 7 with H-antisera. At the bottom of the table space is 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. Indicate for each combination of strain and antiserum if there was agglutination (+) or not (-). If the cell remains empty this indicates that the agglutination was not determined for the specific combination of antiserum and strain.
Please note that in case of deviating results you will be asked to fill in these tables retrospectively!

QUESTIONS SEROTYPING

What was the frequency of serotyping of *Salmonella* at your laboratory in 2009?	☐ Daily ☐ Once a week ☐ Twice a week ☐ Thrice a week ☐ Weekly ☐ Monthly ☐ Other:
How many *Salmonella* strains did your laboratory (approximately) serotype in 2009?	Number of strains:
What kind of sera do you use?	☐ Prepared in own laboratory ☐ Commercial sera Manufacturer(s):
The strains in this EQA scheme were serotyped by:	☐ Own laboratory, ☐ Other laboratory, namely: Strains:

		Strains																			
O-antisera	**Manufacturer**	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
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																					

		Strains																			
O-antisera	**Manufacturer**	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
8																					
14																					
20																					
Group D																					
9																					
9, 12																					
1, 9, 12																					
12																					
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																					

		Strains																			
O-antisera	**Manufacturer**	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
19																					
Group G																					
13																					
13, 22, 23																					
22																					
23																					
Other O-antisera																					

		Strains																			
H-antisera	**Manufacturer**	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
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																					
p																					

		Strains																			
H-antisera	**Manufacturer**	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
q																					
s																					
t																					
u																					
q, s, t, p, u																					
i																					
k																					
L (complex)																					
l, v																					
l, w																					
v																					
w																					
r																					
y																					
z																					
z_6																					
z_{10}																					

		Strains																			
H-antisera	**Manufacturer**	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
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**	**H-antigens (phase 1)**	**H-antigens (phase 2)**	**Serovar name**
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?	☐ Yes ☐ No
If yes, which *Salmonella* strains do you phage type?	☐ *Salmonella* Typhimurium ☐ *Salmonella* Enteritidis ☐ Other(s):
Which typing system is used for:	*Salmonella* Typhimurium: *Salmonella* Enteritidis:
How many strains did your laboratory (approximately) phage type in 2009?	Number of strains:

TEST RESULTS PHAGETYPING

Labcode:		Starting date of phage typing:		Finishing date of phage typing:	

Notations:

- :	no reaction		
+ :	5-20 plaques	(<) CL:	Clear Lysis
+ :	21-40 plaques	(<) OL:	Opaque Lysis
++ :	41-80 plaques	SCL:	Semi Confluent Lysis
+++ :	81-100 plaques	<< :	Merging plaques towards semi-confluent lysis

		Phage reactions at Routine Test Dilution (*S.* Enteritidis)																
Strain number	Phage type	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 PHAGE TYPING

Labcode:		Starting date of phage typing:		Finishing date of phage typing:	

		Phage reactions at Routine Test Dilution (*S.* **Typhimurium)**																	
Strain number	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
T1																			
T2																			
T3																			
T4																			
T5																			
T6																			
T7																			
T8																			
T9																			
T10																			

		Phage reactions at Routine Test Dilution (*S.* **Typhimurium)**											**Additional phages**						
Strain umber	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
T1																				
T2																				
T3																				
T4																				
T5																				
T6																				
T7																				
T8																				
T9																				
T10																				

REMARKS AND COMMENTS

Name of person(s) carrying out the typing:	
Date:	

Name of person in charge:	
Date:	

Annex 3 Protocol for follow-up study

PROTOCOL OF THE FOLLOW-UP OF THE FIFTEENTH INTERLABORATORY COMPARISON STUDY (XV, 2010) ON SEROTYPING OF *SALMONELLA* STRAINS, FOR THE NRL-*SALMONELLA* LABORATORIES

Introduction
In November 2010 the European Reference Laboratory (EU-RL) - *Salmonella* has organised the fifteenth interlaboratory comparison study on the typing of *Salmonella* strains amongst the National Reference Laboratories for *Salmonella* (NRLs-*Salmonella*).
Four (candidate) NRLs did not achieve the level of Good Performance for serotyping in this study, therefore this follow-up is planned in which these NRLs have to serotype an additional set of 10 strains.
The study will take place in week 13 (starting on 28 March 2011). The timetable can be found on the last page of this protocol.

All data have to be reported in the test report, to be sent by e-mail to the EU-RL-*Salmonella* and will be used for analysis.

Transportation of the *Salmonella* strains to the NRLs-*Salmonella*.
The strains will be sent as Biological Substance Category B (UN 3373) with a door-to-door courier to your laboratory.

Serotyping
A total number of 10 *Salmonella* strains (indicated SF 1 till SF 10) 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 EU-RL-*SALMONELLA* WITH MORE INFORMATION IN CASE OF ANY DEVIATING RESULTS.

The results for each strain have to be reported with the formula for the O-antigens and H-antigens **and** the serovar names according to the White-Kauffman-le Minor scheme of 2007 (http://www.pasteur.fr/ip/portal/action/WebdriveActionEvent/oid/01s-000036-089).
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.

Table 1 Evaluation of serotyping results

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	-

Recent information revealed that colonial form variation may occur with the expression of the O:6_1 antigen by some serogroup C_2 serovars (Hendriksen et al., J Clin Microbiol 47(9): 2729-2736). Also for this study on serotyping it was decided to consider the serovar pairs concerned (e.g. as *S.* Newport/*S.* Bardo and *S.* Hadar/*S.* Istanbul in the second EQA) not as distinct serovars.

Please record all test results in the separately provided Test Report file and return this file by e-mail to wilma.jacobs@rivm.nl on **22 April 2011 at the latest**.

A check-up by the participants of the submitted results is no longer needed when the results are sent by email in the provided file format. This will save time, ***but participants need to be sure to fill in the right results at once.***

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

Wilma Jacobs
P.O. Box 1
3720 BA Bilthoven
tel. number: +31-30-2744290
fax number: +31-30-2744434
e-mail: wilma.jacobs@rivm

Timetable of the Follow-up of 15th interlaboratory comparison study (2010) on serotyping of *Salmonella* spp.

Week	Date	Topic
9	4 March 2011	Mailing of the protocol and test report Follow-up study 2010.
12	21 - 25 March 2011	Mailing of the parcels to the participants as Biological Substance Category B (UN 3373) by door-to-door courier service. After arrival at the laboratory the strains need to be sub-cultured and stored until the performance of the typing. **If you did not receive the parcel by 25 March, do contact the EU-RL immediately.**
13	28 March - 1 April	Starting with the identification of the strains.
17	18 - 22 April 2011	Send the completed test report preferably by e-mail to EU-RL-*Salmonella*. **Deadline: 22 April 2011**
18	26 - 29 April 2011	Data input at the EU-RL-*Salmonella*. A check-up of the submitted results by the NRLs is no longer needed when the results are sent by email in the provided file format. This will save time, ***but NRLs need to be sure to fill out the right results at once.***
19	2 – 6 May 2011	Reporting of the individual laboratory results.

Annex 4 Test report, follow-up study

TEST REPORT

FOLLOW-UP OF THE FIFTEENTH INTERLABORATORY COMPARISON STUDY (XV, 2010) ON SEROTYPING OF *SALMONELLA* STRAINS, FOR THE NRL-*SALMONELLA* LABORATORIES

Laboratory code	
Name contact person	
Email address contact person	
Name of laboratory or institute	
Country	

Please write your remarks and comments on page 7 of the test report.

GENERAL QUESTIONS

Shipment of the strains	
Was your parcel damaged at arrival?	
Date of receipt at your laboratory:	

Sub-culturing	
Medium used for sub-culturing 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, ☐ Other laboratory, namely Strains:

REMARKS CONCERNING THE TABLES FOR SEROTYPING

Two tables are added to this test report, to give the EU-RL-*Salmonella* more information about the antisera used. The table on page 4 concern reactions obtained with O-antisera and the table on page 5 with H-antisera. At the bottom of the table space is left to fill in other antisera than already mentioned in the table.
Please mention the manufacturer of the antisera used in the column next to the antisera. Indicate for each combination of strain and antisera tested 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**	SF1	SF2	SF3	SF4	SF5	SF6	SF7	SF8	SF9	SF10
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											
14											
20											
Group D											
9											
9, 12											
1, 9, 12											
12											
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											
Group G											
13											
13, 22, 23											
22											
23											
Other O-antisera											

		Strains									
H-antisera	**Manufacturer**	SF1	SF2	SF3	SF4	SF5	SF6	SF7	SF8	SF9	SF10
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											
p											
q											
s											
t											
u											
q, s, t, p, u											
i											
k											
L (complex)											
l, v											
l, w											
v											
w											
r											
y											
z											
z_6											
z_{10}											
z_{29}											
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**	**H-antigens (phase 1)**	**H-antigens (phase 2)**	**Serovar name**
SF 1				
SF 2				
SF 3				
SF 4				
SF 5				
SF 6				
SF 7				
SF 8				
SF 9				
SF 10				

REMARKS AND COMMENTS

Name of person(s) carrying out the typing:	
Date:	

Name of person in charge:	
Date:	

Annex 5 Serotyping results per strain and laboratory

Lab	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	Y	Lab	
REF	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	4,5,12:i:-	Infantis	Berta		REF	P.P.
1	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	1	0
2	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	**Hadar**/Istanbul	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	2	0
3	Clerkenwell	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	3	0
4	Clerkenwell	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	4	0
5	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	5	0
6	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Sandiego	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	1	6	1
7	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	7	0
8	Preston	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	8	0
9	species	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	9	0
10	Clerkenwell	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	10	0
11	Clerkenwell	Bredeney	Bracknell	Plymouth	O3,19:d:-	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	1	11	0
12	Carno	Bredeney	Bracknell	Plymouth	Wanatah	Assinie	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Uppsala	see Annex 6	Infantis	Berta	3	12	3
13	Cannstatt	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Enteritidis	1	13	4
14	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	14	0
15	3,15:-:l,w	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	15	0
16	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chartres	Agona	Hadar	Typhimurium	Molade	Give	Agona	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	2	16	2
17	Clerkenwell	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	17	0
18	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	18	0
19	O-rough:z:l,w	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	4,12:e,h:-	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	1	19	0
20	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	20	0
21	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	21	0
22	Clerkenwell	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	22	0
23	Svedvi	Bredeney	Oudwijk	Plymouth	Liverpool	Fulda	Chester	Agona	Hadar	Typhimurium	Wippra	Bloomsbury	Derby	Muenster	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Salmonella 1	6	23	5
24	Preston	Bredeney	Bracknell	Weybridge	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	1	24	1
25	Clerkenwell	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	25	0
26	Clerkenwell	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Rissen	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	1	26	1
27	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	27	0
28	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Zerefin	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	1	28	4
29	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	29	0
30	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	S. spp.	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Salmonella spp.	see Annex 6	Infantis	Berta	2	30	0
31	Clerkenwell	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Annex 6	Infantis	Berta	0	31	0
32	Clerkenwell	Bredeney	Bracknell	Plymouth	-	Assinie	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Altendorf	see Annex 6	Infantis	Berta	3	32	2
33	Kossen	Brandenburg	Bracknell	Zega	Tilburg	Meleagridis	Chester	Agona	Hadar/Istanbul	Gloucester	Glostrup	Ruzizi	Hato	Sao	Enteritidis	Virchow	Liverpool	S. Typhimurium	Infantis	Nitra	11	33	14
X	18	1	1	2	4	3	4	0	1	1	2	2	3	2	0	0	4	1	0	3	34		

X = number of deviating laboratories per strain, Y = number of deviating strains per laboratory, P.P. = penalty points (see also section 3.6), REF = reference

Annex 6 Different serovar names reported by the NRL laboratories for strain S18

S18	Lab
4,5,12:i:-	**REF**
S. enterica subsp. enterica, 4,5,12 : i : -	**1**
S. enterica ssp. enterica, (4,[5],12:i:-)	**2**
S. enterica subspecies enterica = 4,5,:i:-	**3**
S. 4,5:i:-	**4**
Monophasic S. Typhimurium (1,4,[5],12:i:-)	**5**
Monophasic S. Typhimurium	**6**
monophasic strain Group B (monophasic S. Typhimurium)	**7**
S. Enterica sub. sp. enterica	**8**
monophasic S. Typhimurium	**9**
(ST-like) 1,4,[5],12:i:-	**10**
Salmonella O4:i:-	**11**
S. enterica subsp. e*nterica*	**12**
4 : i : -	**13**
S. enterica subsp. *enterica* Serotype 4, 5, 12: i: -	**14**
S. enterica subsp. *enterica* Serotype 4, [5], 12: i: -	**15**
Salmonella spp. (S. typhimurium like strains?)	**16**
Salmonella enterica subsp. enterica serovar 4,5,12:i:-	**17**
S. subsp. enterica (4,5,12 : i : -)	**18**
4,5,12:i:- (monophasic)	**19**
Monophasic strain of S. Typhimurium	**20**
S. Typhimurium, monophasisch	**21**
S. 4,5,12:i:-	**22**
-	**23**
SI 4,5,12:i:-	**24**
S. enterica subsp. *enterica* 4,[5], 12:i:-	**25**
monophasic *S.* Typhimurium	**26**
subsp. *enterica* 4,5,12:i:-	**27**
Typhimurium monophasique	**28**
Monophasic variant of *S.* Typhimurium	**29**
Salmonella spp.	**30**
1,4,[5],12 : i : -	**31**
S. enterica subsp. *enterica* 4, [5], 12:i:-	**32**
S. Typhimurium	**33**

Annex 7 Phage typing results per strain and laboratory

-	= no reaction	SCL	= semi-confluent lysis
+	= 5-20 plaques	CL	= confluent clear lysis
+	= 21-40 plaques	OL	= confluent opaque lysis
++	= 41-80 plaques	<<	= merging plaques towards semi-confluent lysis
+++	= 81-100 plaques		

Strain E1		**Phage reactions at routine test dilution (*S.* Enteritidis)**																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**55**	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
5	**55**	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
7	**55**	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
19	**55**	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
21	**55**	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
22	**55**	-	SCL	-	-	-	<OL	-	-	-	-	-	-	-	-		-	-
27	**55**	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
29	**55**	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-

Strain E2		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**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	SCL	CL	OL	OL	SCL	CL	CL	CL	SCL	OL	OL	SCL
5	**1b**	OL	SCL	CL	SCL	CL	SCL	CL	OL	<OL	OL	CL	CL	SCL	SCL	+++	SCL	OL
7	**1b**	OL	SCL	CL	<OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	CL	SCL	<OL	<OL
19	**1b**	OL	OL	OL	SCL	OL	SCL	OL	OL	OL	OL	OL	OL	OL	OL	OL	OL	OL
21	**1b**	SCL	SCL	CL	++	CL	<SCL	CL	SCL	+++	+++	<CL	CL	CL	<CL	<CL	<CL	<OL
22	**1b**	OL	SCL	CL	SCL	CL	<OL	<CL	<OL	<OL	<OL	<CL	CL	CL	OL		<OL	SCL
27	**1b**	OL	SCL	CL	<OL	CL	SCL	CL	OL	<OL	OL	CL	CL	CL	CL	<OL	OL	<OL
29	**1b**	OL	SCL	CL	SCL	CL	SCL	SCL	OL	OL	OL	CL	CL	SCL	SCL	<OL	OL	<OL

Strain E3		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**15a**	-	-	++	-	CL	+++	-	OL	-	OL	-	CL	CL	-	-	-	-
5	**15a**	-	-	+++	-	CL	+++	-	<OL	-	<OL	-	CL	CL	-	-	-	-
7	**15a**	-	-	++<<	-	CL	<SCL	-	OL	-	OL	-	CL	CL	-	-	-	-
19	**15a**	-	-	++	-	CL	SCL	-	OL	-	SCL	-	CL	CL	-	-	-	-
21	**15a**	-	-	++	-	CL	<SCL	-	OL	-	<OL	-	<CL	CL	-	-	-	-
22	**15a**	-	-	SCL	-	CL	<OL	-	OL	-	OL	-	CL	CL	-		-	-
27	**15a**	-	-	++	-	OL	SCL	-	OL	-	OL	-	CL	CL	-	-	-	-
29	**15a**	-	-	++	-	CL	SCL	-	OL	-	<OL	-	OL	OL	-	-	-	-

Strain E4		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	6a	-	SCL	-	OL	-	SCL	-	-	<OL	-	-	-	-	-	-	-	SCL
5	**6a**	-	SCL	-	SCL	-	SCL	-	-	OL	-	-	-	-	-	-	-	OL
7	**6a**	-	SCL	-	SCL	-	SCL	-	-	<OL	-	-	-	-	-	-	-	SCL
19	**6a**	-	SCL	-	SCL	-	SCL	-	-	SCL	-	-	-	-	-	-	-	OL
21	**6a**	-	<SCL	-	+	-	SCL	-	-	+	-	-	-	-	-	-	-	<OL
22	**6a**	-	SCL	-	SCL	-	<OL	-	-	SCL	-	-	-	-	-		-	SCL
27	**6a**	-	SCL	-	SCL	-	SCL	-	-	<OL	++	-	-	-	-	-	-	<CL
29	**6a**	-	SCL	-	SCL	-	SCL	-	-	<OL	-	-	-	-	-	-	-	<OL

Strain E5		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**13a**	-	-	-	OL	-	SCL	-	OL	OL	SCL	-	-	-	-	-	-	SCL
5	**13a**	-	-	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	OL
7	**13a**	-	-	-	SCL	-	<SCL	-	<OL	<OL	<OL	-	-	-	-	-	-	<OL
19	**13a**	-	-	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	OL
21	**13a**	-	-	-	++	-	<SCL	-	OL	++	<OL	-	-	-	-	-	-	<OL
22	**13a**	-	-	-	SCL	-	<OL	-	<OL	SCL	<OL	-	-	-	-		-	SCL
27	**13a**	-	-	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	<OL
29	**13a**	-	-	-	SCL	-	SCL	-	OL	<OL	<OL	-	-	-	-	-	-	<OL

Strain E6		Phage reactions at routine test dilution (*S*. Enteritidis)																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**6**	-	SCL	-	OL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	SCL
5	**6**	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	OL
7	**6**	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	<OL
19	**6**	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	OL
21	**6**	-	<SCL	-	<SCL	-	<SCL	-	OL	<OL	<OL	-	-	-	-	-	-	<OL
22	**6**	-	SCL	-	SCL	-	<OL	-	SCL	SCL	<OL	-	-	-	-		-	SCL
27	**6**	-	SCL	-	SCL	-	SCL	-	OL	<OL	OL	-	-	-	-	-	-	<OL
29	**6**	-	SCL	-	SCL	-	SCL	-	OL	<OL	<OL	-	-	-	-	-	-	<OL

Strain E7		Phage reactions at routine test dilution (*S*. Enteritidis)																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**8**	-	-	SCL	<OL	CL	SCL	<CL	OL	OL	<OL	CL	CL	-	-	-	-	SCL
5	**8**	-	-	SCL	SCL	CL	SCL	+++	OL	OL	OL	++	SCL	-	-	-	-	OL
7	**8**	-	-	SCL	SCL	CL	SCL	SCL	CL	OL	CL	SCL	CL	-	-	-	-	<OL
19	**8**	-	-	SCL	SCL	CL	SCL	OL	OL	OL	OL	SCL	CL	-	-	-	-	OL
21	**8**	-	-	<SCL	+++	CL	SCL	<SCL	OL	++	<OL	+	SCL	-	-	-	-	<OL
22	**8**	-	-	+++	SCL	CL	<OL	++	OL	SCL	OL	+++	CL	-	-		-	SCL
27	**8**	-	-	SCL	SCL	CL	SCL	SCL	OL	OL	OL	SCL	CL	-	-	-	-	<OL
29	**8**	-	-	SCL	SCL	SCL	SCL	+++	OL	<OL	<OL	+++	SCL	-	-	-	-	<OL

Strain E8		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**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	SCL	CL	OL	OL	<OL	CL	CL	CL	<CL	-	-	SCL
5	**1**	OL	SCL	CL	SCL	CL	SCL	CL	OL	<OL	OL	CL	CL	SCL	SCL	-	-	OL
7	**1**	OL	SCL	CL	<OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	OL
19	**1**	SCL	SCL	SCL	SCL	CL	SCL	SCL	OL	OL	OL	CL	CL	CL	CL	-	-	OL
21	**1**	OL	<SCL	CL	<SCL	CL	<SCL	CL	OL	+++	<OL	CL	CL	CL	<CL	-	-	<OL
22	**1**	OL	SCL	CL	SCL	CL	<OL	<CL	OL	<OL	OL	<CL	CL	CL	CL		-	SCL
27	**1**	OL	SCL	CL	<OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	<OL
29	**1**	OL	SCL	SCL	SCL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	<OL

Strain E9		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**13**	-	-	-	SCL	-	SCL	-	-	SCL	-	-	-	-	-	-	-	++
5	**13**	-	-	-	SCL	-	SCL	-	-	OL	-	-	-	-	-	-	-	OL
7	**13**	-	-	-	SCL	-	SCL	-	-	OL	-	-	-	-	-	-	-	SCL
19	**13**	-	-	-	++	-	SCL	-	-	SCL	-	-	-	-	-	-	-	OL
21	**14b**	-	-	-	±	-	<SCL	-	-	±	-	-	-	-	-	-	-	<SCL
22	**13**	-	-	-	SCL	-	<OL	-	-	SCL	-	-	-	-	-		-	SCL
27	**13**	-	-	-	SCL	-	SCL	-	-	<OL	-	-	-	-	-	-	-	SCL
29	**13**	-	-	-	+++	-	SCL	-	-	<OL	-	-	-	-	-	-	-	<OL

Strain E10		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**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	SCL	CL	OL	OL	<OL	CL	CL	CL	-	-	-	SCL
5	**4**	-	SCL	CL	SCL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	-	-	-	OL
7	**4**	-	SCL	CL	SCL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	-	-	-	<OL
19	**4**	-	SCL	CL	SCL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	-	-	-	OL
21	**4**	-	SCL	CL	<SCL	CL	SCL	CL	OL	+++	<OL	CL	CL	CL	-	-	-	<OL
22	**4**	-	SCL	<CL	SCL	CL	<OL	<CL	OL	SCL	OL	<CL	CL	CL	-		-	SCL
27	**4**	-	SCL	CL	SCL	CL	SCL	CL	OL	<OL	OL	CL	CL	CL	-	-	-	<OL
29	**4**	-	SCL	SCL	SCL	CL	SCL	SCL	OL	<OL	<OL	CL	CL	CL	-	-	-	<OL

Strain T1		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T1		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10VAR2	10VAR3	18
HPA	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	±	-
5	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-	-
7	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	±	SCL	3	-
19	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-	-
21	U310	-	-	-	-	-	-	-	-	-	-	-	-	±	±	+	-	OL	±	-
22	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	±	OL	-	-
29	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	±	<OL	-	-

Strain T2		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T2		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10VAR2	10VAR3	18
HPA	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	OL
5	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	<OL	++
7	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	++	++	<SCL
19	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL
21	208	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	<OL	<OL	<OL	<OL
22	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	<OL	SCL	+
29	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	<OL	<OL	<OL

Strain T3		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**46a**	-	SCL	OL	OL	OL	OL	-	-	OL	OL	-	-	OL	OL	OL	OL	-	OL
5	**46a**	-	SCL	CL	CL	SCL	CL	-	-	+++	CL	-	-	CL	CL	CL	CL	-	CL
7	**46a**	-	<OL	OL	OL	OL	OL	-	-	OL	OL	-	-	OL	OL	OL	OL	-	<OL
19	**46a**	-	SCL	OL	OL	OL	OL	-	-	OL	OL	-	-	OL	OL	OL	OL	-	OL
21	**46a**	-	<CL	CL	CL	<CL	CL	-	-	SCL	CL	-	-	CL	CL	CL	CL	-	CL
22	**46a**	-	++	<OL	OL	OL	OL	-	-	<OL	OL	-	-	OL	OL	OL	OL	-	<OL
29	**46a**	-	CL	SCL	CL	CL	SCL	-	-	CL	CL	-	-	CL	CL	CL	CL	-	SCL

Strain T3		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**46a**	SCL	OL	OL	OL	OL	OL	OL	OL	OL	OL	OL	OL	+	+	+	-	-	-	OL
5	**46a**	SCL	CL	SCL	SCL	CL	+++	SCL	CL	CL	CL	SCL	CL	+	+	+	-	-	-	CL
7	**46a**	<OL	OL	<OL	<OL	OL	<OL	OL	OL	OL	OL	<OL	OL	+	+++	+	-	-	-	OL
19	**46a**	OL	OL	OL	OL	OL	OL	OL	OL	OL	OL	OL	OL	+	+	+	-	-	-	OL
21	**46a**	<CL	CL	CL	<CL	CL	CL	CL	CL	CL	CL	CL	CL							
22	**46a**	SCL	<OL	SCL	<OL	OL	OL	OL	OL	OL	OL	OL	OL	±	+	+	-	-	-	OL
29	**46a**	SCL	SCL	SCL	SCL	SCL	CL	SCL	SCL	CL	CL	SCL	OL							

Strain T4		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**7**	-	-	-	-	-	-	OL	-	-	-	-	-	-	-	-	-	CL	-
5	**7**	-	-	-	-	-	-	OL	-	-	-	-	-	-	-	-	-	SCL	-
7	**7**	-	-	-	-	-	-	<OL	2	-	-	-	-	-	-	-	-	<CL	-
19	**59**	-	-	-	-	-	-	++	-	-	-	-	4	-	-	-	-	+	-
21	**7**	-	-	-	-	-	-	+++	-	-	-	-	-	-	-	-	-	<SCL	-
22	**7**	-	-	-	-	-	-	++	-	-	-	-	-	-	-	-	-	<CL	-
29	**7**	-	-	-	-	-	-	+++	-	-	-	-	-	-	-	-	-	SCL	-

Strain T4		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**7**	+	-	-	-	-	-	-	-	-	-	OL	-	+	+	+	SCL	OL	OL	-
5	**7**	SCL	-	-	-	-	-	-	-	-	±	±	-	+	++	+	OL	OL	<OL	-
7	**7**	++	-	-	-	-	-	-	-	-	-	++	-	±	++	+	OL	SCL	SCL	-
19	**59**	SCL	-	-	-	-	-	-	-	-	-	SCL	-	+	+	+	OL	OL	OL	-
21	**7**	++	-	-	-	-	-	-	-	-	-	+++	-							
22	**7**	++	-	-	-	-	-	-	-	-	-	+++	-	±	++	++	<OL	<OL	SCL	-
29	**7**	SCL	-	-	-	-	-	-	-	-	-	<SCL	-							

Strain T5		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**15a**	-	-	-	-	-	-	-	-	-	OL	CL	CL	-	OL	-	OL	-	SCL
5	**15a**	-	-	-	-	-	-	-	-	-	CL	CL	CL	-	SCL	-	CL	-	SCL
7	**15a**	-	-	-	-	-	-	-	-	-	OL	<CL	<CL	-	OL	-	CL	-	<OL
19	**15a**	-	-	-	-	-	-	-	-	-	SCL	CL	CL	-	OL	-	SCL	-	SCL
21	**15a**	-	-	-	-	-	-	-	-	-	OL	<CL	CL	-	<OL	-	OL	-	<SCL
22	**15a**	-	-	-	-	-	-	-	-	-	<OL	<CL	CL	-	SCL	-	OL	-	SCL
29	**15a**	-	-	-	-	-	-	-	-	-	SCL	SCL	CL	-	CL	-	CL	-	SCL

Strain T5		Phage reactions at routine test dilution (*S.* Typhimurium)											Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**15a**	SCL	-	-	-	-	-	-	-	-	-	OL	-	+	+	+	OL	OL	OL	+
5	**15a**	SCL	-	-	-	-	-	-	+	-	-	SCL	++	+	+	+	OL	OL	<OL	++
7	**15a**	OL	-	-	-	-	-	-	±<<	-	-	<OL	1	++	+++	++	<OL	SCL	SCL	5
19	**15a**	SCL	-	-	-	-	-	-	-	-	-	SCL	3	+	+	+	OL	OL	OL	-
21	**15a**	SCL	-	-	-	-	-	-	±	-	-	OL	-							
22	**15a**	++	-	-	-	-	-	-	-	-	+	<OL	-	±	±	±	<OL	OL	SCL	-
29	**15a**	SCL	-	-	-	-	-	-	±	+	-	OL	±							

Strain T6		Phage reactions at routine test dilution (*S*. Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**24**	-	-	SCL	-	-	-	-	-	-	-	-	-	CL	-	-	-	-	-
5	**24**	-	-	SCL	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-
7	**24**	-	-	<SCL	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-
19	**24**	-	-	OL	-	-	-	-	-	-	-	-	-	++	-	-	-	-	-
21	**24**	-	-	SCL	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-
22	**24**	-	-	SCL	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-
29	**24**	-	-	+++	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-

Strain T6		Phage reactions at routine test dilution (*S*. Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**24**	-	-	-	-	CL	-	CL	-	-	-	-	-	+	+	+	SCL	OL	OL	±
5	**24**	-	-	-	-	SCL	-	SCL	-	-	-	-	-	-	-	-	OL	OL	<OL	-
7	**24**	-	-	-	-	SCL	-	CL	-	-	-	-	-	+	+++	++	OL	SCL	SCL	-
19	**24**	-	-	-	-	++	-	++	-	-	-	-	-	+	+	+	OL	OL	OL	-
21	**24**	-	-	-	-	SCL	-	SCL	-	-	-	-	-							
22	**24**	-	-	-	-	SCL	-	<CL	-	-	-	-	-	±	+	+	<OL	OL	SCL	-
29	**24**	-	-	-	-	+++	-	SCL	-	-	-	-	-							

Strain T7		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**15**	-	-	-	-	-	-	-	-	-	OL	CL	CL	-	OL	-	OL	CL	++
5	**15**	-	-	-	-	-	-	-	-	-	OL	SCL	SCL	-	OL	-	OL	SCL	++
7	**15**	-	-	-	-	-	-	-	-	-	<OL	SCL	SCL	-	OL	-	<OL	SCL	++
19	**15**	-	-	-	-	-	-	-	-	-	SCL	CL	CL	-	OL	-	SCL	SCL	SCL
21	**15**	-	-	-	-	-	-	-	-	-	SCL	<SCL	<SCL	-	SCL	-	SCL	SCL	++
22	**15**	-	-	-	-	-	-	-	-	-	<OL	SCL	OL	-	<CL	-	<OL	<CL	SCL
29	**15**	-	-	-	-	-	-	-	-	-	+++	<OL	<OL	-	CL	-	CL	SCL	SCL

Strain T7		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**15**	SCL	-	-	-	-	-	-	-	-	-	OL	-	±	±	±	OL	OL	OL	±
5	**15**	SCL	-	-	-	-	-	-	+	-	-	OL	++	+	+	+	OL	OL	<OL	++
7	**15**	<SCL	-	-	-	-	-	-	+	3	-	SCL	5	+	+++	++	<OL	SCL	SCL	-
19	**15**	SCL	-	-	-	-	-	-	-	-	-	SCL	-	+	+	+	OL	OL	OL	-
21	**15**	+++	-	-	-	-	-	-	±	-	-	SCL	-							
22	**15**	++	-	-	-	-	-	-	-	-	±	<OL	-	+	++	++	OL	OL	SCL	-
29	**15**	SCL	-	-	-	-	-	-	±	-	-	<OL	±							

Strain T8		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
HPA	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T8		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10VAR2	10VAR3	18
HPA	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-
5	193	-	-	-	-	-	-	-	-	-	-	-	-	++	++	++	-	-	-	-
7	193	-	-	-	-	-	-	-	-	-	-	-	-	++	SCL	++	-	-	-	-
19	193	-	-	-	-	-	-	-	-	-	-	-	-	++	++	++	-	-	-	-
21	193	-	-	-	-	-	-	-	-	-	-	-	-	<SCL	<SCL	SCL	-	-	-	-
22	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-
29	193	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	-	-	-	-

Strain T9		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**104**	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	+++	-
5	**104**	-	-	-	-	-	-	-	-	-	-	+++	SCL	-	-	-	-	++	-
7	**104**	-	-	-	-	-	-	-	-	-	-	+<<	+<<	-	-	-	-	+	-
19	**104**	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	+	-
21	**104**	-	-	-	-	-	-	-	-	-	-	+	SCL	-	-	-	-	+	-
22	**104**	-	-	-	-	-	-	-	-	-	-	+	CL	-	-	-	-	±	-
29	**104**	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	+++	-

Strain T9		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**104**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
5	**104**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	<OL	-
7	**104**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	SCL	SCL	-
19	**104**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
21	**104**	-	-	-	-	-	-	-	-	-	-	-	-							
22	**104**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	OL	SCL	-
29	**104**	-	-	-	-	-	-	-	-	-	-	-	-							

Strain T10		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**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
5	**36**	SCL	SCL	CL	CL	SCL	CL	CL	CL	<SCL	CL	<SCL	SCL	CL	CL	CL	CL	CL	CL
7	**36**	CL	<CL	CL	CL	CL	CL	CL	CL	CL	CL	SCL	SCL	CL	CL	CL	CL	CL	<CL
19	**36**	SCL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
21	**36**	SCL	CL	CL	CL	<CL	CL	CL	SCL	<CL	CL	SCL	<CL	CL	CL	CL	CL	<CL	CL
22	**36**	<CL	SCL	<CL	OL	OL	<CL	SCL	<CL	<CL	CL	SCL	CL	OL	OL	OL	OL	<CL	OL
29	**36**	OL	SCL	SCL	CL	CL	SCL	SCL	SCL	<CL	<CL	SCL	SCL	CL	CL	CL	CL	SCL	SCL

Strain T10		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**36**	CL	OL	OL	CL	CL	CL	CL	CL	OL	CL	CL	OL	++	++	++	OL	OL	OL	CL
5	**36**	SCL	CL	CL	CL	CL	+++	CL	CL	CL	CL	CL	OL	++	++	++	OL	OL	<OL	OL
7	**36**	<CL	CL	CL	CL	CL	<CL	CL	CL	CL	CL	<CL	CL	+	+++	+	OL	SCL	SCL	CL
19	**36**	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	+	+	+	OL	OL	OL	OL
21	**36**	<CL	CL	CL	<CL	CL	CL	CL	CL	OL	CL	CL	OL							
22	**36**	SCL	OL	<OL	<CL	<CL	CL	OL	OL	OL	OL	OL	OL	±	+	+	<OL	OL	SCL	SCL
29	**36**	SCL	SCL	SCL	+++	SCL	CL	SCL	SCL	CL	CL	SCL	OL							

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