National Institute for Public Health
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Fourteenth CRL-*Salmonella* interlaboratory comparison study (2009) on typing of *Salmonella* spp.

RIVM report 330604021/2011

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Colophon

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Abstract

Fourteenth CRL-*Salmonella* interlaboratory comparison study (2009) on typing of *Salmonella* spp.

The National Reference Laboratories (NRLs) of all 27 European Member States, as well as the NRLs of Croatia, Norway and Switzerland performed well on the 2009 quality control test on *Salmonella* typing. Five laboratories were found to require a follow-up study on their first test but all 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 93 per cent 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 twenty *Salmonella* strains. NRLs from countries outside the European Union occasionally participate in these tests on a voluntary basis. Norway and Switzerland, and Croatia as an EU-candidate country took part in the 2009 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 per cent of the *S.* Typhimurium strains correctly. Of the *S.* Enteritidis strains, 94 per cent were phage typed correctly.

The Community Reference Laboratory for *Salmonella* (CRL-*Salmonella)* organises this annual interlaboratory comparison study on typing of *Salmonella* 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, interlaboratory comparison study.

Rapport in het kort

Veertiende CRL-*Salmonella* ringonderzoek (2009) voor de typering van *Salmonella* spp.

De Nationale Referentie Laboratoria (NRL's) van de 27 Europese lidstaten en de NRLs van Kroatië, Noorwegen en Zwitserland scoorden in 2009 goed bij de kwaliteitscontrole op *Salmonella*-typering. Vijf laboratoria hadden hiervoor een herkansing nodig. Uit de analyse van alle NRL's als groep bleek dat de laboratoria aan 93 procent 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 2009 waren dat Noorwegen en Zwitserland, en Kroatië als kandidaat-lidstaat voor de Europese Unie.

Van de NRL's zijn er zeven laboratoria die, naast de standaardtoets (serotypering) op *Salmonella*, preciezere typeringen uitvoeren, de zogeheten faagtypering. Voor deze kwaliteitstoets moeten zij 20 extra stammen met deze methode typeren. De laboratoria ontvingen hiervoor tien *Salmonella* Enteritidis-stammen en tien *Salmonella* Typhimurium-stammen. Deze NRL's typeerden 98 procent van de *S.* Typhimurium-stammen en 94 procent van de *S.* Enteritidis-stammen op de juiste wijze.

De organisatie van het typeringsringonderzoek 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) in Bilthoven, Nederland. De organisatie van dit ringonderzoek is uitgevoerd in samenwerking met de Health Protection Agency (HPA) in Londen, Engeland.

Trefwoorden: CRL-*Salmonella, Salmonella* spp., serotypering, faagtypering.

Contents

Summary

In November 2009, the fourteenth interlaboratory comparison study on typing of *Salmonella* was organised by the 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*) 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 and Croatia. All 31 NRLs performed serotyping. A total of 20 strains of *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 if this is part of their usual routine procedure.

Overall, 97% of the strains were typed correctly for the O-antigens, 94% of the strains were typed correctly for the H-antigens and 93% of the strains were correctly named by the NRLs.
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, 26 NRLs achieved this level of good performance. The five NRLs which did not achieve the level of good performance received 10 additional strains for serotyping. All five NRLs achieved the level of good performance in this follow-up study.

Seven of the participating NRLs-*Salmonella* also performed phage typing. Six NRLs participated in the phage typing of both *S.* Enteritidis and *S.* Typhimurium. One NRL participated only in the phage typing of *S.* Enteritidis. The HPA selected 20 strains for phage typing. Ten were of the serovar *Salmonella* Enteritidis (SE) and ten of the serovar *Salmonella* Typhimurium (STM). The phage typing results of the majority of the laboratories were good. The seven NRLs phage typed 94% of the *Salmonella* Enteritidis strains correctly and six NRLs correctly phage typed 98% of the *Salmonella* Typhimurium strains.

List of abbreviations

CRL-*Salmonella*	Community Reference Laboratory for *Salmonella*
EFTA	European Free Trade Association
HPA	Health Protection Agency
LGP	Laboratory of Gastrointestinal Pathogens
NL	The Netherlands
NRLs-*Salmonella*	National Reference Laboratories for *Salmonella*
Nt	Not typable
PT	Phage Type
REF	Reference
RIVM	National Institute for Public Health and the Environment
SE	*Salmonella* Enteritidis
STM	*Salmonella* Typhimurium
UK	United Kingdom

1 Introduction

This report describes the fourteenth interlaboratory comparison study on the typing of *Salmonella* spp. organised by the Community Reference Laboratory for *Salmonella* (CRL-*Salmonella*, Bilthoven, the Netherlands), in November 2009.

According to 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.

A total of 31 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 CRL-*Salmonella,* had to participate in a follow-up study in which 10 additional strains were serotyped.
Seven of the NRLs-*Salmonella* performed phage typing on 10 *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 Salmonellosis 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
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 *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
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 Veterninária 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
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 mailing. 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 14th CRL- Salmonella typing study*

Strain No.	**O-antigens**	**H-antigens**	**Serovar**
S1	1,3,19	z_{29}:[z_6]	*S*. Llandoff
S2	3,{10}{15}	l,v:1,6	*S*. London
S3	6,7,14	r:1,5	*S*. Infantis
S4	8	e,h:1,2	*S*. Bardo
S5	1,4,[5],12,[27]	d:1,2	*S*. Stanley
S6	1,9,12	g,m:-	*S*. Enteritidis
S7	1,4,[5],12	f,g:[1,2]	*S*. Derby
S8	6,8	z_{10}:e,n,x	*S*. Hadar
S9	6,7,14	r:1,2	*S*. Virchow
S10	3,{10}{15}	y:z_6	*S*. Stockholm
S11	1,4,[5],12	f,g,s:[1,2]	*S*. Agona
S12	1,4,[5],12	i:1,2	*S*. Typhimurium
S13	4,[5],12	l,v:e,n,z_{15}	*S*. Brandenburg
S14	9,12	l,v:1,7	*S*. Kapemba
S15	1,13,23	b:1,5	*S*. Mississippi
S16	13,22	z:1,5	*S*. Winslow
S17	6,7,14	b:l,w	*S*. Ohio
S18	6,7,14	k:1,5	*S*. Thompson
S19	1,4,[5],12	i:1,5	*S*. Lagos
S20	8,20	r,[i]:z_6	*S*. Altona

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 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 14th CRL-*Salmonella *typing study*

		Phages 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	6	-	SCL	-	OL	-	SCL	-	OL	<OL	OL	-	-	-	-	-	-	<OL
E2	22	OL	-	-	SCL	-	+++	-	OL	OL	OL	-	-	-	CL	-	-	SCL
E3	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
E4	1	OL	SCL	CL	OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	SCL
E5	3	OL	-	-	-	-	++	-	OL	-	OL	-	-	-	CL	-	-	-
E6	4	-	SCL	CL	OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	-	-	-	<OL
E7	14b	-	-	-	±	-	SCL	-	-	±	-	-	-	-	-	-	-	OL
E8	1b	OL	SCL	CL	OL	CL	SCL	CL	OL	<OL	<OL	CL	CL	CL	CL	<OL	CL	<OL
E9	21	OL	SCL	-	<OL	-	SCL	-	OL	OL	OL	-	-	-	CL	-	-	<OL
E10	14c	-	-	-	-	-	+++	-	-	-	-	-	-	-	-	-	-	-

Table 3 Phage reactions of the Salmonella Typhimurium *strains used in the 14th CRL-*Salmonella *typing study*

		Phages 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**
T11	10	-	-	-	-	-	-	-	-	CL	OL	CL	CL	-	-	<CL	-	-	-
T12	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T13	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T14	36	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
T15	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T16	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	++	-
T17	1	CL	CL	CL	OL	CL	CL	CL	-	CL	OL	CL	CL	CL	CL	CL	CL	SCL	CL
T18	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T19	8	-	-	-	-	-	-	-	+++	SCL	CL	-	-	-	-	+++	-	-	-
T20	40	CL	CL	CL	CL	CL	CL	CL	-	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL

		Phages 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**
T11	10	<CL	-	OL	CL	-	++	+	-	-	CL	CL	-	+	+	+	OL	OL	OL	-
T12	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-
T13	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	SCL
T14	36	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	+++	++	+++	OL	OL	OL	OL
T15	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+++	-	-	-	-
T16	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
T17	1	CL	CL	CL	CL	CL	CL	CL	CL	-	CL	CL	CL	+++	++	+++	OL	OL	OL	OL
T18	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-
T19	8	SCL	-	SCL	SCL	-	++	+	-	-	CL	SCL	-	+	+	+	<OL	OL	OL	-
T20	40	CL	CL	CL	CL	CL	CL	CL	CL	-	CL	CL	OL	+	+	+	OL	OL	OL	OL

3.3 Laboratory codes

The NRLs-*Salmonella* were assigned a laboratory code 1-31, 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 CRL-*Salmonella* in week 48, 2009.

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 CRL-*Salmonella* workshop in Bilthoven in May 2007 (Mooijman, 2007), the CRL-*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 organised for NRLs with four penalty points or more. All NRLs 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 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 10 Salmonella *strains according to the White-Kauffmann-LeMinor scheme used in the Follow-up part of the 14th CRL-*Salmonella *typing study*

Strain No.	**O-antigens**	**H-antigens**	**Serovar**
SF1	6,7,14	r:1,5	*S.* Infantis
SF2	1,4,[5],12	f,g:[1,2]	*S.* Derby
SF3	1,3,19	g,[s],t:-	*S.* Senftenberg
SF4	8	e,h:1,2	*S.* Bardo
SF5	6,7	r:1,7	*S.* Colindale
SF6	6,8,20	e,h:1,2	*S.* Newport
SF7	1,4,[5],12	i:1,2	*S.* Typhimurium
SF8	6,8	z_{10}:e,n,x	*S.* Hadar
SF9	3,{10},{15}	l,v:1,7	*S.* Give
SF10	4,12	i:1,6	*S.* Agama

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 2 NRLs received their package in the same week as it was sent (week 48 of 2009). Two NRLs received their package in week 49 of 2009.

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 2008?
Question 5: How many strains did your laboratory (approximately) serotype in 2008?
Replies to questions 4 and 5 are summarised in Table 6.

Table 6 Frequency and number of strains serotyped in 2008

Laboratory code NRLs	Typing frequency	Number of strains serotyped in 2008	Laboratory code NRLs	Typing frequency	Number of strains serotyped in 2008
1	Daily	568	**17**	Daily	1000
2	Thrice a week	200	**18**	Daily	5100
3	Weekly	3500	**19**	Daily	2000
4	Daily	850	**20**	Daily	5500
5	Daily	2330	**21**	Daily	792
6	Twice a week	123	**22**	Weekly	319
7	Daily	5000	**23**	Daily	276
8	Thrice a week	436	**24**	Twice a week	347
9	Weekly	155	**25**	Daily	900
10	Daily	5655	**26**	Daily	4000
11	Daily	150	**27**	Daily	795
12	Daily	6800	**28**	Daily	228
13	Daily	1000	**29**	Daily	2000
14	Daily	680	**30**	Daily	2800
15	Weekly	83	**31**	Weekly	100
16	Thrice a week	72			

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

*no info from 1 laboratory

Table 8 Number of laboratories using sera from different manufacturers

Name of manufacturer	Number of NRLs (n=30*)
Becton Dickinson (BD)	2
Biomed	1
Biorad	12
BUL-BIO	1
Dade Behring	1
Denka Seiken	2
Difco	1
Imuna	1
Immunolab	1
Mast Group Ltd	2
Prolab	4
Reagensia AB	2
Remel	1
Sifin	19
Statens Serum Institute	26
Own laboratory	5

*no info from 1 laboratory

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

One NRL-Salmonella (laboratory code 2) sent two strains to another laboratory for further serotyping and one NRL (labcode 27) sent one strain to another laboratory for further serotyping. All other laboratories tested all strains in their own laboratory.

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 2008?

The replies to question 10 are summarised in Table 9.

Table 9 Number of phage typings in 2008

Laboratory codes	Number of strains phage typed in 2008
3	1000
5	1165
10	3650
12	2059
18	2200
20	4900
26	250

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. Twenty-three Laboratories (laboratory codes 1, 3, 4, 5, 7, 8, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 23, 25, 26, 27, 28, 29 and 30) typed all O-antigens correctly. Fourteen laboratories (laboratory codes 1, 2, 3, 5, 10, 11, 12, 14, 17, 18, 20, 28, 29, and 30) typed all H-antigens correctly and 15 laboratories (laboratory codes 1, 2, 3, 5, 7, 10, 11, 12, 14, 17, 18, 20, 28, 29, and 30) identified all serovar names correctly.
The O-antigens were typed correctly by 74% of the NRLs. This corresponds to 97% of the total amount of strains. The H-antigens were typed correctly by 45% of the NRLs, corresponding to 94% of the total amount of strains. And 48% of the NRLs gave the correct serovar names, corresponding to 93% of all strains.

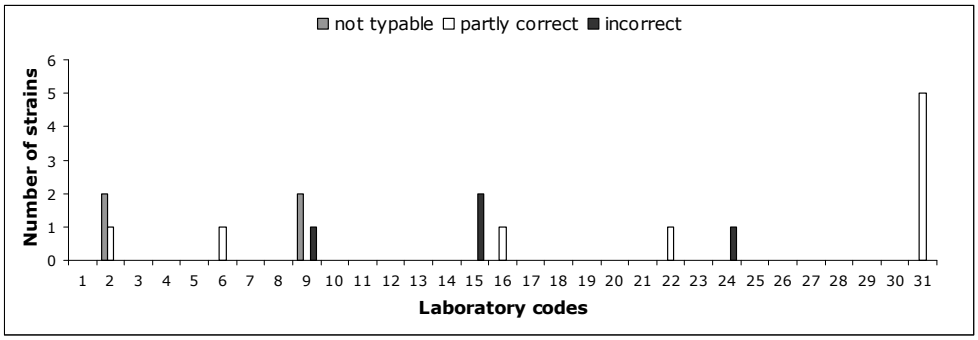

Figure 1 Evaluation of serotyping of O-antigens per NRL

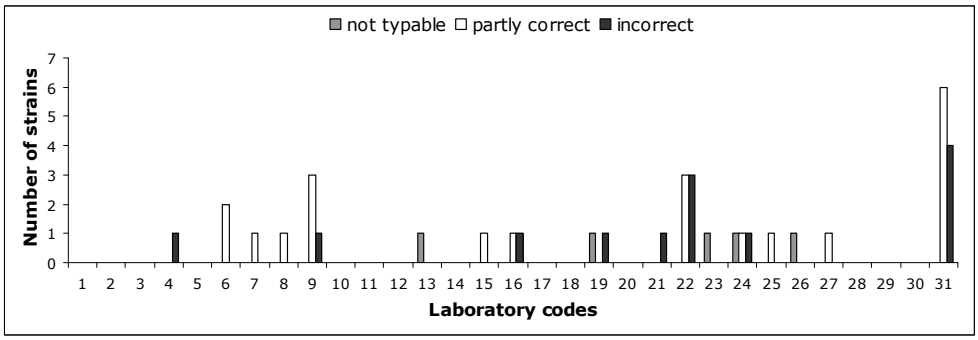

Figure 2 Evaluation of serotyping of H-antigens per NRL

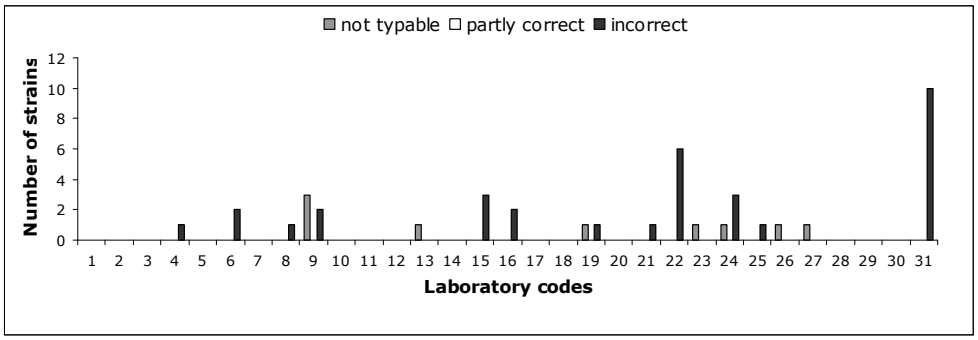

Figure 3 Evaluation of the correct serovar names per NRL

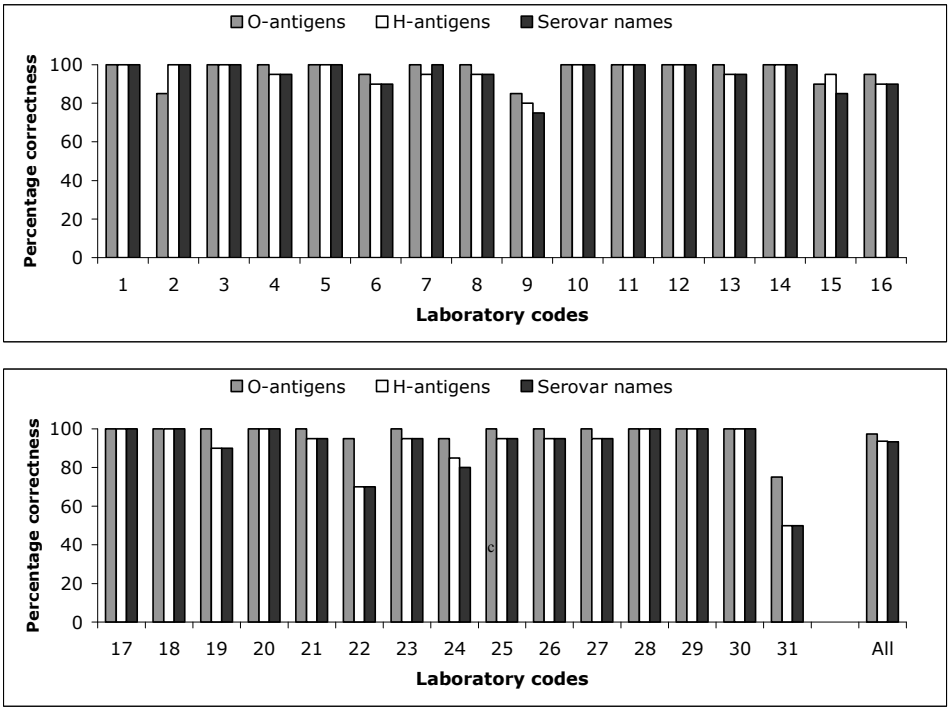

Figure 4 Achievements of the serotyping in percentages that were correct

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. Five NRLs did not meet the level of Good Performance at this stage of the study and these laboratories participated in the follow-up study, serotyping an additional ten *Salmonella* strains.

Table 10 Evaluation of serotyping results per NRL

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

5.1.2 Serotyping results per strain

Results reported per strain and per NRL are given in Annex 5.
A completely correct identification by all participants was obtained for four strains: *S.* Stanley (S5), *S.* Enteritidis (S6), *S.* Agona (S11), and *S.* Brandenburg (S13).
Most problems occurred with the serovars *S*. Llandoff (S1), and *S.* Thompson (S18). 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	Serovar	Labcode
S1	**1,3,19**	**z29:[z6]**	**S. Llandoff**	**REF**
	1,3,19	Rz27:-	*S.* Senftenberg	4
	1,3,19	z:z6	*S.* Hongkong	6
	19	g,t	S. Senftenberg	9
	19	-	-	13
	3,19	g,t	Senftenberg	19
	1,3,19	g,[s],t:-	*Salmonella* Senftenberg	21
	1,3,19	g,[s],t:-	Senftenberg	24
	1,3,19	-	O:1,3,19 (E4) serogroup	26
	3,10	z; l,w	Salmonella Clerkenwell	31
S2	**3,{10}{15}**	**l,v:1,6**	**S. London**	**REF**
	4,12	l,v:1,6	Clackamas	24
	1,3,19	z; l,w	Salmonella Carno	31
S3	**6,7,14**	**r:1,5**	**S. Infantis**	**REF**
	13,23	r,e,n,z15	S. Linton	9
	6,7	y; 1,5	Salmonella Bareilly	31
S4	**8**	**e,h:1,2**	**S. Bardo**	**REF**
	6,8,20	e,h:1,2	*S*. Newport	6
	6,8	e,h:1,2	*S. newport*	15
	8,2	e,h:1,2	Newport	16
	6,8	e,h:1,2	S. Newport	23
	6,8,20	e,h:1,2	*Salmonella* Newport	26
	6,8	e,h;e,n,x	Salmonella Fillmore	31
S7	**1,4,[5],12**	**f,g:[1,2]**	**S. Derby**	**REF**
	4,5	f,g,t:z6	Agona	16
	4,12	f,g,t:z6	S. Agona	22
S8	**6,8**	**z10:e,n,x**	**S. Hadar**	**REF**
	8	z10:e,n,x	Istanbul	12
	8	e,n,x:z10	Istanbul	16
	6,8	e,h:e,n,x	Salmonella Fillmore	31
S9	**6,7,14**	**r:1,2**	**S. Virchow**	**REF**
	6,7,14	y:e,n,z15	S. Mikawasima	22
S10	**3,{10}{15}**	**y:z6**	**S. Stockholm**	**REF**
	3,1	y:z45	Amager	8
	3,1	y:e,n,x	S. Ohlstedt	22
	3,1	y:1,5	Salmonella Orion	31
S12	**1,4,[5],12**	**i:1,2**	**S. Typhimurium**	**REF**
	4,5,12	f,g	Salmonella Derby	31
S14	**9,12**	**l,v:1,7**	**S. Kapemba**	**REF**
	9	l,z13:1,7	*S. miyazaki*	15
	9,12	l,v:1,5	S. Panama	22
S15	**1,13,23**	**b:1,5**	**S. Mississippi**	**REF**
	13,22,23	b:1,5	Salmonella spp.	9
	13,22	z:1,5	Salmonella Winslow	31
S16	**13,22**	**z:1,5**	**S. Winslow**	**REF**
	13,22,23	5,z44	Salmonella spp.	9
	13,22	-:5	O13,22 : - 5	19
	13,22	-:1,5	Salmonella sp. (comments)	27
S17	**6,7,14**	**b:l,w**	**S. Ohio**	**REF**
	4	b:l,w	*S. wien*	15
	Auto-agglutination	b:auto-agglutination		30
	6,7	d;l,w	Salmonella Livingstone	31
S18	**6,7,14**	**k:1,5**	**S. Thompson**	**REF**
	6,7	l,v:1,5	Salmonella spp.	9
	4	k:1,5	*S. massenya*	15
	6,7	t:1,5	Montevideo	16
	6,7,14	z29: -	S. Tennessee	22
	7	y:1,5	S. Bareilly	23
	6,7,14	r:1,5:[R1],[z37],[z45],[z4	Infantis	24
	6,7	l,v:1,5	Iruma	25
S19	**1,4,[5],12**	**i:1,5**	**S. Lagos**	**REF**
	4	i:1,2	S. Typhimurium	23
	4*	i:-	4:i:- ("Typhimurium-like")	24
S20	**8,20**	**r,[i]:z6**	**S. Altona**	**REF**
	6,8,20	r,i:1,5	*S*. Bovismorbificans	6
	6,8,20	r:1,5	S. Bovismorbificans	22
	6,8	d:1,5	Salmonella Manhattan	31

5.1.3 *Follow-up study*

Five NRLs did not achieve the level of good performance (Table 10) and were therefore included in the follow-up study. These NRLs (labcodes 9, 22, 23, 24, and 31) received 10 additional strains for serotyping in week 16, 2010.
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.

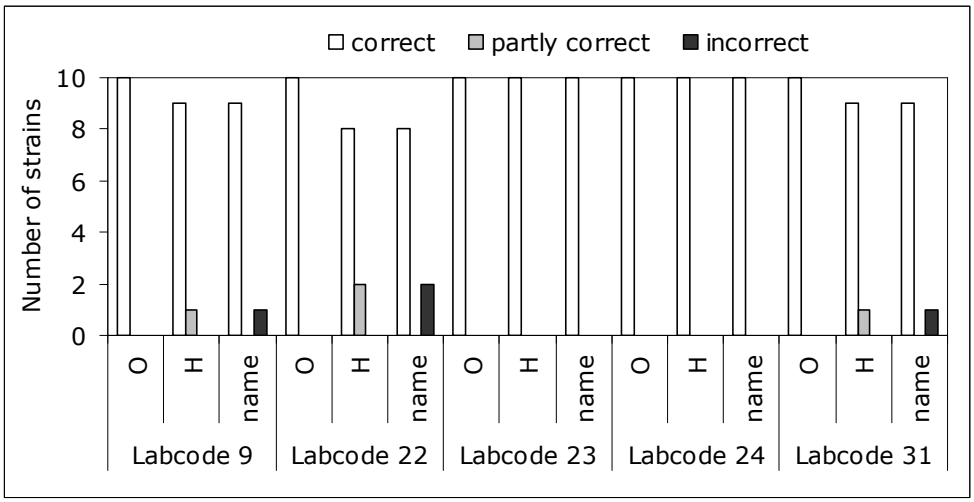

Figure 5 Evaluation of serotyping O- and H-antigens and of the serovar names by the NRLs during the follow-up study

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 five 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*

	Salmonella strain numbers											
Lab	SF1	SF2	SF3	SF4	SF5	SF6	SF7	SF8	SF9	SF10		
REF	**Infantis**	**Derby**	**Senftenberg**	**Bardo/ Newport**	**Colindale**	**Newport**	**Typhimurium**	**Hadar**	**Give**	**Agama**	**Y**	**P.P.**
9	Infantis	Derby	Senftenberg or Dessau	Bardo	Colindale	Newport	Typhimurium	Hadar	Give	Agama	1	1
22	Infantis	Derby	Senftenberg	Bardo	Gatow	Newport	Typhimurium	Hadar	Give	Lagos	2	2
23	Infantis	Derby	Senftenberg	Newport	Colindale	Newport	Typhimurium	Hadar	Give	Agama	0	0
24	Infantis	Derby	Senftenberg	Bardo	Colindale	Newport	Typhimurium	Hadar	Give	Agama	0	0
31	Infantis	Derby	Senftenberg	Bardo	Colindale	Newport	Typhimurium	Hadar	Give	Tumodi	1	1
X	0	0	1	0	1	0	0	0	0	2		

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

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

Labcode	Penalty Points	Good Performance
9	1	Yes
22	2	Yes
23	0	Yes
24	0	Yes
31	1	Yes

5.2 Phage typing results of the NRLs-*Salmonella*

Six NRLs participated in the phage typing of both *S*. Enteritidis and *S*. Typhimurium. One NRL only participated in the phage typing of *S*. Enteritidis. The 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.
Four laboratories (laboratory codes 3, 5, 10 and 18) assigned the correct phage type for all ten of the *S*. Enteritidis stains. Two laboratories each incorrectly typed one of the *S*. Enteritidis strains and one laboratory incorrectly phage typed two of the ten strains.
Five laboratories (labcodes 5, 10, 12, 20 and 26) assigned the correct phage type to all ten strains of *S.* Typhimurium and one laboratory correctly phage typed nine of the *S.* Typhimurium strains.
Two of the laboratories correctly phage typed all of the *S.* Enteritdis and all of the *S.* Typhimurium strains.
Overall, 94% 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 6.

Table 14 Results of Salmonella *Enteritidis phage typing*

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
HPA	**6**	**22**	**59**	**1**	**3**	**4**	**14b**	**1b**	**21**	**14c**
3	6	22	59	1	3	4	14b	1b	21	14c
5	6	22	59	1	3	4	14b	1b	21	14c
10	6	22	59	1	3	4	14b	1b	21	14c
12	6	22	59	1	3	4	14b	1b	21c	14c
18	6	22	59	1	3	4	14b	1b	21	14c
20	6	22	59	49	3	4	14b	1b	21	14c
26	6	22	59	37	3	4	14b	1b	21c	14c

Grey cells = deviating results

Table 15 Results of Salmonella *Typhimurium phage typing*

	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
HPA	**10**	**U311**	**208**	**36**	**195**	**104**	**1**	**193**	**8**	**40**
5	10	U311	208	36	195	104	1	193	8	40
10	10	U311	208	36	195	104	1	193	8	40
12	10	U311	208	36	195	104	1	193	8	40
18	10	U311	U302	36	195	104	1	193	8	40
20	10	U311	208	36	195	104	1	193	8	40
26	10	U311	208	36	195	104	1	193	8	40

Grey cells = deviating results.

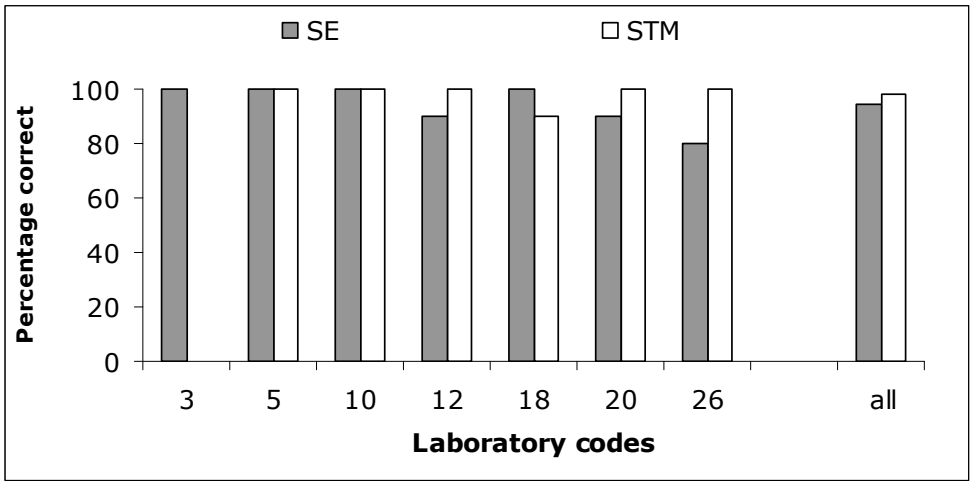

Figure 6 Percentage of strains correctly phage typed for each laboratory

6 Discussion

Serotyping
A total of 28 NRLs-*Salmonella* of the 27 Member States of the European Union participated in this fourteenth interlaboratory comparison study on typing of *Salmonella*, as well as the NRLs of Norway, Switzerland, and Croatia. A total of 20 strains of the species *Salmonella enterica* subspecies *enterica* were sent to the participants in November 2009 for serotyping by all 31 NRLs.
Overall, 97% of the strains were typed correctly for the O-antigens, 94% of the strains were typed correctly for the H-antigens and 93% of the strains were correctly named by the NRLs.
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, 26 NRLs achieved this level of good performance. The five NRLs which did not achieve the level of good performance received 10 additional strains for serotyping. All five NRLs achieved the level of good performance in this follow-up study.

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. One mistake was made with typing *S.* Typhimurium, *S.* Hadar and *S.* Virchow; and two mistakes were made when serotyping *S.* Infantis. In the follow-up study, *S.* Infantis, *S.* Typhimurium and *S.* Hadar were typed correctly by all NRLs.

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 16 Details on the serotyping studies for EU-NRLs only

Study	**XII**	**XIII**	**XIV**
Year	**2007**	**2008**	**2009**
N participants	25	28-1=27	28
N strains evaluated	20	20	20
O-antigens correct/strains	490/500 (98%)	529/540 (98%)	551/560 (98%)
H-antigens correct/strains	477/500 (95%)	528/540 (98%)	532/560 (95%)
Strains correct/strains	473/500 (95%)	521/540 (97%)	529/560 (95%)
O-antigens correct/labs	17/25 (68%)	19/27 (70%)	21/28 (75%)
H-antigens correct/labs	14/25 (56%)	18/27 (67%)	12/28 (43%)
Strains correct/labs	13/25 (52%)	14/27 (52%)	13/28 (46%)
Total # PP	35	30	36
Total # non-Good Performance	6	3	4
Total # non-GP after Follow-up	0	0	0

Table 17 Details on the serotyping studies for all participants

Study	XII	XIII	XIV
Year	**2007**	**2008**	**2009**
N participants	26	30-1=29	31
N strains evaluated	20	20	20
O-antigens correct/strains	510/520 (98%)	568/580 (98%)	603/620 (97%)
H-antigens correct/strains	497/520 (96%)	568/580 (98%)	581/620 (94%)
Strains correct/strains	493/520 (95%)	560/580 (97%)	578/620 (93%)
O-antigens correct/labs	18/26 (69%)	22/29 (76%)	23/31 (74%)
H-antigens correct/labs	15/26 (58%)	21/29 (72%)	14/31 (45%)
Strains correct/labs	14/26 (54%)	17/29 (59%)	15/31 (48%)
Total # PP	36	34	56
Total # non-Good Performance	6	4	5
Total # non-GP after Follow-up	0	0	0

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 four of the seven NRLs. One NRL incorrectly typed two of the *S.* Enteritidis strains, E4 (PT1) and E9 (PT21). Two of the NRLs incorrectly typed one strain each (strain E4 (PT1) by one laboratory and strain E9 (PT21) by the other). Both laboratories that incorrectly phage typed strain E4 (PT1) had low or no phage reactions with phages that should have had high readings. The results for the other strains obtained by these two laboratories suggest that the phages were being used at the correct dilution, so there may have been a problem with the inoculum size of the broth culture used for the typing of this strain. The two laboratories that incorrectly typed strain E9 (PT21) typed it as PT21c. These two phage types are differentiated by the reaction obtained with phage 16. PT21 shows no or a very low reaction with this phage and PT21c has a high reaction with this phage. This suggests phage 16 was not used at the correct dilution.

Five of the NRLs correctly phage typed all ten of the *S.*Typhimurium strains. The remaining laboratory correctly phage typed nine of the strains. This laboratory incorrectly phage typed strain T13 (PT208) as PT U302. *S.* Typhimurium PT 208 reacts with additional phage 18 and this laboratory did not obtain any reaction with this phage. This suggests the titre of the phage suspension used was too low.

Overall, the phage typing results for this study were good, with 94% of the *S.* Enteritidis strains correctly phage typed. This is the same result as the previous study in 2008. The results for *S.* Typhimurium were better than the 2008 study. In 2008, 97% of the *S.* Typhimurium strains were correctly typed and in this study 98% were correctly phage typed.

7 Conclusions

Serotyping

- 97% of the strains were typed correctly for the O-antigens.
- 94% of the strains were typed correctly for the H-antigens.
- 93% of the strains were correctly named.
- Serotyping of *S.* Llandoff and *S.* Thompson caused most problems in this study.
- Five NRLs did not achieve the level of Good Performance.
- In the follow-up study, those 5 NRLs all achieved the level of Good Performance.

Phage typing

- 94% of the *S.* Enteritidis strains were typed correctly.
- 98% of the *S*. Typhimurium strains typed correctly.
- 8/10 *S.* Enteritidis strains were correctly typed by all 7 participating laboratories.
- 9/10 *S*. Typhimurium strains were correctly typed by all 6 participating laboratories.
- Two of the *S.* Enteritidis strains caused a problem, E4 (PT1) and E9 (PT21), both incorrectly typed by two laboratories.
- Only one *S.* Typhimurium strain caused a problem, T13 (PT208) and it was incorrectly typed by one laboratory.

References

Grimont, P.A.D. and Weill, F-X., 2007. Antigenic formulae of the *Salmonella* serovars, 9th ed. WHO Collaborating Centre for Reference and Research on Salmonella. Institute Pasteur, Paris, France. http://www.pasteur.fr/sante/clre/cadrecnr/salmoms/WKLM_2007.pdf (visited 13-04-2010).

Hendriksen et al., 2009. WHO Global Salm-Surv External Quality Assurance System for Serotyping of *Salmonella* Isolates from 2000 to 2007. J Clin Microbiol 47(9): 2729-2736.

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

Regulation (EC) No 882/2004 of the European parliament and of the counsel 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.

Annex 1 Protocol

PROTOCOL OF THE FOURTEENTH INTERLABORATORY COMPARISON STUDY (XIV, 2009) ON SEROTYPING AND PHAGE TYPING OF *SALMONELLA* STRAINS ORGANISED BY CRL-*SALMONELLA*

Introduction
The Community Reference Laboratory (CRL) - *Salmonella* organises the fourteenth 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 49 (starting on 30 November 2009. The timetable can be found on the last page of this protocol.
All data have to be reported in the test report, send to the CRL-*Salmonella* and will be used for analysis. The data on phage typing will be forwarded by CRL-*Salmonella* to HPA for further analyses.

Transportation of the *Salmonella* strains to the NRLs-*Salmonella*.
CRL-*Salmonella* will transport the strains for serotyping and for phage typing (if applicable) in a separate parcel. The strains will be send as Biological Substance Category B (UN 3373) with a door-to-door courier to your laboratory.

Serotyping
A total number of 20 *Salmonella* strains (indicated S-1 till S-20) 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 DEVIATING RESULTS.

The results for each strain have to be reported with the full 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/sante/clre/cadrecnr/salmoms/WKLM_2007.pdf).
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 CRL-*Salmonella* 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	-

Phage typing

The participating 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 T11-T20

The evaluation of the phage typing results will be done in collaboration with the *Salmonella* Reference Unit of the Health Protection Agency (HPA), London, United Kingdom.

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

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

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

Timetable of the 14th interlaboratory comparison study (2009) on serotyping and phage typing of *Salmonella* spp.

Week	Date	Topic
46	9–13 November	Mailing of the protocol and test report 2009
48	23-27 November	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 27 November, do contact the CRL immediately.**
49	30 November – 4 December	Starting with the identification of the strains.
51	14-18 December	Send the completed test report preferably by e-mail to CRL-*Salmonella*. **Deadline: 18 December 2009**
1-2010	4-8 January 2010 and onwards	Data input at CRL-*Salmonella* 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.
2010	Mid January 2010 and onwards	Reporting of the results

Annex 2 Test report

TEST REPORT

FOURTEENTH INTERLABORATORY COMPARISON STUDY ON TYPING OF *SALMONELLA* STRAINS (2009), FOR THE NATIONAL REFERENCE LABORATORIES FOR *SALMONELLA*

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:…… Phagetyping: 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 page 11 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	

Sub-culturing	
Medium used for sub-culturing 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 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 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 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 *Salmonella* at your laboratory in 2008?	❑ Daily ❑ Once a week ❑ Twice a week ❑ Thrice a week ❑ Weekly ❑ Monthly ❑ Other: ……
How many *Salmonella* strains did your laboratory (approximately) serotype in 2008?	Number of 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, ❑ 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											
Group G											
13											
13, 22, 23											
22											
23											

CRL-*Salmonella*, Bilthoven, the Netherlands

		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											
Group G											
13											
13, 22, 23											
22											
23											

CRL-*Salmonella*, Bilthoven, the Netherlands

		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											

CRL-*Salmonella*, Bilthoven, the Netherlands

		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											

CRL-*Salmonella*, Bilthoven, the Netherlands

TEST RESULTS SEROTYPING

Labcode	
Starting date of serotyping	
Finishing date of serotyping	

Strain no.	O-antigens detected	H-antigens detected	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 2008?	Number of strains……...

TEST RESULTS PHAGE TYPING

Labcode	
Starting date of phage typing	
Finishing date of phage typing	

		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
T11																			
T12																			
T13																			
T14																			
T15																			
T16																			
T17																			
T18																			
T19																			
T20																			

		Phage reactions at Routine Test Dilution (*S.* Typhimurium)											Additional phages						
Strain number	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
T11																				
T12																				
T13																				
T14																				
T15																				
T16																				
T17																				
T18																				
T19																				
T20																				

Notations:

- -: no reaction
- ±: 5-20 plaques
- +: 21-40 plaques
- ++: 41-80 plaques
- +++: 81-100 plaques
- O*: O pooled
- (<)CL: clear lysis
- (<)OL: opaque lysis
- SCL: semi confluent lysis
- <<: Merging plaques towards semi-confluent lysis

CRL-*Salmonella*, Bilthoven, the Netherlands

REMARKS AND COMMENTS

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

Name of person in charge	
Date (and signature)	

Annex 3 Protocol for Follow-up study

PROTOCOL OF THE FOLLOW-UP OF THE FOURTEENTH INTERLABORATORY COMPARISON STUDY (XIV, 2009) ON SEROTYPING OF *SALMONELLA* STRAINS ORGANISED BY CRL-*SALMONELLA*

Introduction
In December 2009 the Community Reference Laboratory (CRL) - *Salmonella* has organised the fourteenth interlaboratory comparison study on the typing of *Salmonella* strains amongst the National Reference Laboratories for *Salmonella* (NRLs-*Salmonella*).
Eight 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 17 (starting on 26 April 2010). The timetable can be found on the last page of this protocol.

All data have to be reported in the test report, to be send by e-mail to the CRL-*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 CRL-*SALMONELLA* WITH MORE INFORMATION IN CASE OF ANY DEVIATING RESULTS.

The results for each strain have to be reported with the full 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/sante/clre/cadrecnr/salmoms/WKLM_2007.pdf).
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 CRL-*Salmonella* 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	-

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 14th interlaboratory comparison study (2009) on serotyping of *Salmonella* spp.

Week	Date	Topic
15	12-16 April 2010	Mailing of the protocol and test report Follow-up study
16	19-23 April 2010	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 23 April, do contact the CRL immediately.**
17	26-30 April 2010	Starting with the identification of the strains.
20	17-21 May 2010	Send the completed test report preferably by e-mail to CRL-*Salmonella*. **Deadline: 21 May 2010**
21	25-28 May 2010	Data input at CRL-*Salmonella* 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.
23	7-11 June 2010	Reporting of the results

Annex 4 Test report, Follow-up study

TEST REPORT

FOLLOW-UP
OF THE FOURTEENTH INTERLABORATORY COMPARISON STUDY (XIV, 2009) ON SEROTYPING OF *SALMONELLA* STRAINS, ORGANISED BY THE CRL-*SALMONELLA*

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:…… Phagetyping: 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 page 7 of the test report!!

GENERAL QUESTIONS

Shipment of serotyping strains	
Was your parcel damaged at arrival?	❑ NO ❑ YES
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 extra tables are added to this test report, to give the CRL-*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**	**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											
Group G											
13											
13, 22, 23											
22											
23											
Other O-antisera											

CRL-*Salmonella*, Bilthoven, the Netherlands

		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_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 detected	H-antigens detected	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

	Salmonella strain numbers																						
Lab	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20		Lab	
REF	**Llandoff**	**London**	**Infantis**	**Bardo/ Newport**	**Stanley**	**Enteritidis**	**Derby**	**Hadar/ Istanbul**	**Virchow**	**Stockholm**	**Agona**	**Typhimurium**	**Brandenburg**	**Kapemba**	**Mississippi**	**Winslow**	**Ohio**	**Thompson**	**Lagos**	**Altona**	**Y**	**REF**	**P.P.**
1	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**1**	0
2	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**2**	0
3	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**3**	0
4	Senftenberg	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	1	**4**	1
5	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**5**	0
6	Hongkong	London	Infantis	Newport	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Bovismorbificans	2	**6**	2
7	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**7**	0
8	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Amager	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	1	**8**	1
9	Senftenberg	London	Linton	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Salmonella spp.	Salmonella spp.	Ohio	Salmonella spp.	Lagos	Altona	5	**9**	5
10	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**10**	0
11	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**11**	0
12	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Istanbul	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**12**	0
13	-	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	1	**13**	0
14	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**14**	0
15	Llandoff	London	Infantis	Newport	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	miyazaki	Mississippi	Winslow	wien	massenya	Lagos	Altona	3	**15**	3
16	Llandoff	London	Infantis	Newport	Stanley	Enteritidis	Agona	Istanbul	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Montevideo	Lagos	Altona	2	**16**	2
17	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**17**	0
18	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**18**	0
19	Senftenberg	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	O13,22 : - 5	Ohio	Thompson	Lagos	Altona	2	**19**	1
20	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**20**	0
21	Senftenberg	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	1	**21**	1
22	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Agona	Hadar	Mikawasima	Ohlstedt	Agona	Typhimurium	Brandenburg	Panama	Mississippi	Winslow	Ohio	Tennessee	Lagos	Bovismorbificans	6	**22**	9
23	Llandoff	London	Infantis	Newport	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Bareilly	Typhimurium	Altona	2	**23**	5
24	Senftenberg	Clackamas	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Infantis	4:i:-	Altona	4	**24**	6
25	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Iruma	Lagos	Altona	1	**25**	1
26	O:1,3,19 (E_4)	London	Infantis	Newport	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	1	**26**	0
27	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Salmonella spp.	Ohio	Thompson	Lagos	Altona	1	**27**	0
28	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**28**	0
29	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	Ohio	Thompson	Lagos	Altona	0	**29**	0
30	Llandoff	London	Infantis	Bardo	Stanley	Enteritidis	Derby	Hadar	Virchow	Stockholm	Agona	Typhimurium	Brandenburg	Kapemba	Mississippi	Winslow	auto aggl.	Thompson	Lagos	Altona	1	**30**	0
31	Clerckenwell	Carno	Bareilly	Fillmore	Stanley	Enteritidis	Derby	Fillmore	Virchow	Orion	Agona	Derby	Brandenburg	Kapemba	Winslow	Winslow	Livingstone	Thompson	Lagos	Manhattan	10	**31**	19
X	9	2	2	1	0	0	2	1	1	3	0	1	0	2	2	3	3	7	2	3	44		

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

Annex 6 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		

		Phages reactions at Routine Test Dilution (*S.* Enteritidis) Strain E1																
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**	**-**	**-**	**-**	**-**	**-**	**-**	**<OL**
3	6	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	OL
5	6	-	SCL	-	SCL	-	SCL	-	<OL	<OL	OL	-	-	-	-	-	-	<OL
10	6	-	SCL	-	SOL	-	+++ns	-	<OL	<OL	<OL	-	-	-	-	-	-	OL
12	6	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	OL
18	6	-	++	-	±±	-	SCL	-	<OL	SCL	<OL	-	-	-	-	-	-	SCL
20	6	0	+++	0	SOL	0	<OL	0	<OL	SOL	OL	0	0	0	0	0	0	SOL
26	6	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	<OL

		Phages reactions at Routine Test Dilution (*S.* Enteritidis) Strain E2																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**22**	**OL**	**-**	**-**	**SCL**	**-**	**+++**	**-**	**OL**	**OL**	**OL**	**-**	**-**	**-**	**CL**	**-**	**-**	**SCL**
3	22	OL	-	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	CL	-	-	SCL
5	22	OL	-	-	SCL	-	SCL	-	<OL	<OL	OL	-	-	-	CL	-	-	SCL
10	22	OL	-	-	<OL	-	<SCL	-	OL	<OL	OL	-	-	-	CL	-	-	OL
12	22	OL	-	-	SCL	-	SCL	-	OL	SCL	OL	-	-	-	CL	-	-	SCL
18	22	OL	-	-	++	-	SCL	-	OL	SCL	OL	-	-	-	SCL	-	-	SCL
20	22	CL	0	0	SOL	0	<OL	0	OL	SOL	OL	0	0	0	<CL	0	0	SOL
26	22	OL	-	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	SCL	-	-	OL

		Phages reactions at Routine Test Dilution (*S.* Enteritidis) Strain E3																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**59**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**<OL**
3	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL
5	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL
10	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
12	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL
18	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
20	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	SOL
26	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL

		Phages reactions at Routine Test Dilution (*S.* Enteritidis) Strain E4																
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**
3	1	OL	SCL	CL	<OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	OL
5	1	OL	SCL	CL	OL	CL	SCL	CL	<OL	OL	OL	CL	CL	SCL	CL	-	-	<OL
10	1	OL	<SCL	CL	<OL	CL	<SCL	CL	OL	<OL	OL	CL	CL	CL	CL	-	-	<OL
12	1	OL	CL	CL	CL	CL	SCL	CL	CL	CL	CL	CL	CL	CL	CL	-	-	SCL
18	1	SCL	++	CL	+	CL	<SCL	CL	SCL	±±	+++	CL	CL	CL	<SCL	-	-	+++
20	49	<CL	+	CL	++	CL	OL	<CL	<OL	+	OL	SCL	CL	CL	+++/<SO1	0	0	++
26	37	OL	-	CL	-	CL	SCL	OL	OL	-	OL	CL	CL	CL	CL	-	-	-

		Phages reactions at Routine Test Dilution (*S.* Enteritidis) Strain E5																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**3**	**OL**	**-**	**-**	**-**	**-**	**++**	**-**	**OL**	**-**	**OL**	**-**	**-**	**-**	**CL**	**-**	**-**	**-**
3	3	OL	-	-	-	-	-	-	OL	-	OL	-	-	-	CL	-	-	-
5	3	OL	-	-	-	-	++	-	OL	-	OL	-	-	-	CL	-	-	-
10	3	OL	-	-	-	-	'++mμ	-	OL	-	OL	-	-	-	CL	-	-	-
12	3	OL	-	-	-	-	-	-	OL	-	OL	-	-	CL	-	-	-	-
18	3	SCL	-	-	-	-	+	-	SCL	-	+++	-	-	-	SCL	-	-	-
20	3	OL	0	0	0	0	SOL	0	OL	0	<OL	0	0	0	CL	0	0	0
26	3	OL	-	-	-	-	+++	-	OL	-	OL	-	-	-	SCL	-	-	-

		Phages reactions at Routine Test Dilution (*S.* Enteritidis) Strain E6																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	4	SCL	-	CL	SCL	-	-	±	-	-	CL	SCL	-	0	0	0	0	0
10	4	CL	-	OL	CL	-	-	<SCL	-	-	CL	CL	-	-	-	-	OL	OL
12	4	SCL	-	SCL	SCL	-	±	±	-	-	CL	CL	-	±	±	±	OL	OL
18	4	<SCL	-	<< SCL	SCL	-	-1	-2	-	-	CL	CL	-	0	0	0	0	0
20	4	SCL	0	SCL	CL	0	3p	+/-	0	0	CL	CL	0	++	+	+	OL	OL
26	4	SCL	±	CL	CL	-	±	±	-	-	CL	CL	-	-	-	-	OL	OL

		Phages reactions at Routine Test Dilution (*S.* Enteritidis) Strain E7																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**14b**	**-**	**-**	**-**	**+**	**-**	**SCL**	**-**	**-**	**+**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**OL**
3	14b	-	-	-	+	-	SCL	-	-	+	-	-	-	-	-	-	-	OL
5	14b	-	-	-	±	-	SCL	-	-	±	-	-	-	-	-	-	-	<OL
10	14b	-	-	-	± ns	-	<SCL	-	-	± ns	-	-	-	-	-	-	-	<OL
12	14B	-	-	-	+	-	SCL	-	-	-	-	-	-	-	-	-	-	SCL
18	14b	-	-	-	-	-	SCL	-	-	-2	-	-	-	-	-	-	-	<OL
20	14b	0	0	0	2p	0	OL	0	0	0	0	0	0	0	0	0	0	SOL
26	14b	-	-	-	-	-	SCL	-	-	±	-	-	-	-	-	-	-	<OL

		Phages reactions at Routine Test Dilution (*S.* Enteritidis) Strain E8																
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**	**<OL**	**CL**	**CL**	**CL**	**CL**	**<OL**	**CL**	**<OL**
3	1b	OL	CL	CL	OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	CL	SCL	SCL	OL
5	1b	OL	SCL	CL	OL	CL	SCL	SCL	<OL	<OL	OL	SCL	CL	SCL	SCL	OL	SCL	<OL
10	1b	OL	SCL	CL	OL	CL	<SCL	CL	<OL	<OL	<OL	CL	CL	CL	CL	<OL	<OL	OL
12	1B	CL	SCL	CL	SCL	CL	SCL	SCL	OL	OL	OL	CL	CL	CL	CL	SCL	SCL	SCL
18	1b	SCL	SCL	CL	SCL	CL	SCL	CL	±±±	SCL	±±±	<CL	CL	CL	SCL	±	SCL	SCL
20	1b	<CL	SCL	CL	SOL	CL	<OL	<CL	OL	SOL	<OL	SCL	CL	CL	CL	0	<CL	SOL
26	1b	OL	++	CL	OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	SCL	++	CL	<OL

		Phages reactions at Routine Test Dilution (*S.* Enteritidis) Strain E9																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**21**	**OL**	**SCL**	**-**	**<OL**	**-**	**SCL**	**-**	**OL**	**OL**	**OL**	**-**	**-**	**-**	**CL**	**-**	**-**	**<OL**
3	21	OL	SCL	-	SCL	-	SCL	-	OL	<OL	OL	-	-	-	CL	+	+	<OL
5	21	OL	SCL	-	<OL	-	CL	-	OL	<OL	OL	-	-	-	CL	-	+	<OL
10	21	OL	SCL	-	OL	-	SOL	-	OL	<OL	OL	-	-	-	CL	-	-	OL
12	21C	OL	SCL	-	SCL	-	SCL	-	OL	SCL	OL	-	-	-	OL	SCL	SCL	SCL
18	21	OL	±±	-	±±	-	SCL	-	OL	SCL	OL	-	-	-	SCL	-	-	SCL
20	21	CL	++	0	SOL/ ++	0	CL	0	OL	++	OL	0	0	0	CL	0	0	+
26	21C	OL	++	-	OL	-	SCL	-	OL	OL	OL	-	-	-	SCL	++	sCL	OL

		Phages reactions at Routine Test Dilution (*S.* Enteritidis) Strain E10																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**14c**	**-**	**-**	**-**	**-**	**-**	**+++**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3	14c	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
5	14c	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
10	14c	-	-	-	-	-	<SOL	-	-	-	-	-	-	-	-	-	-	-
12	14C	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
18	14c	-	-	-	-	-	<SCL	-	-	-	-	-	-	-	-	-	-	-
20	14c	0	0	0	0	0	<OL	0	0	0	0	0	0	0	0	0	0	0
26	14c	-	-	-	-	-	OL	-	-	-	-	-	-	-	-	-	-	-

Strain T11		Phages 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	**10**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**CL**	**OL**	**CL**	**CL**	**-**	**-**	**<CL**	**-**	**-**	**-**
3																			
5	10	-	-	-	-	-	-	-	-	+++	SCL	SCL	CL	-	-	SCL	-	-	-
10	10	-	-	-	-	-	-	-	-	CL	CL	CL	CL	-	-	<SCL	-	-	-
12	10	-	-	-	-	-	-	-	-	SCL	SCL	CL	CL	-	-	++	-	-	-
18	10	-	-	-	-	-	-	-	-	SCL	CL	<CL	CL	-	-	<SCL	-	-	-
20	10	0	0	0	0	0	0	0	0	<CL	<CL	<CL	CL	0	0	<CL	0	0	0
26	10	-	-	-	-	-	-	-	-	++	CL	CL	SCL	-	-	+++	-	-	-

Strain T11		Phages 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**	**10 var 2**	**10 var 3**	**18**
HPA	10	<CL	-	OL	CL	-	++	+	-	-	CL	CL	-	+	+	+	OL	OL	OL	-
3																				
5	10	SCL	-	CL	SCL	-	-	±	-	-	CL	SCL	-	0	0	0	0	0	0	0
10	10	CL	-	OL	CL	-	-	<SCL	-	-	CL	CL	-	-	-	-	OL	OL	<OL	-
12	10	SCL	-	SCL	SCL	-	±	±	-	-	CL	CL	-	±	±	±	OL	OL	OL	-
18	10	<SCL	-	<< SCL	SCL	-	-1	-2	-	-	CL	CL	-	0	0	0	0	0	0	0
20	10	SCL	0	SCL	CL	0	3p	+/-	0	0	CL	CL	0	++	+	+	OL	OL	SOL	0
26	10	SCL	±	CL	CL	-	±	±	-	-	CL	CL	-	-	-	-	OL	OL	OL	-

Strain T12		Phages 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	**U311**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3																			
5	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	U311	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T12		Phages 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**	**10 var 2**	**10 var 3**	**18**
HPA	**U311**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**OL**	**-**
3																				
5	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	-
10	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	-
12	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-
18	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<SCL	-
20	U311	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<OL	0
26	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	-

Strain T13		Phages 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**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3																			
5	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	208	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T13		Phages 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**	**10 var 2**	**10 var 3**	**18**
HPA	**208**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**SCL**	**SCL**	**SCL**	**SCL**
3																				
5	208	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	OL
10	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	<OL	SOL	<SOL
12	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	OL
18	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	±s	-	SCL	OL	++	-
20	208	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<OL	<OL	SOL	SOL
26	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	<OL	OL

Strain T14		Phages 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**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**
3																			
5	36	SCL	SCL	SCL	CL	SCL	CL	CL	SCL	SCL	CL	SCL	CL	CL	CL	CL	CL	SCL	CL
10	36	<CL	SCL	CL	CL	CL	CL	CL	CL	CL	CL	<CL	<CL	CL	CL	CL	CL	CL	<CL
12	36	SCL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
18	36	<CL	<SCL	CL	CL	SCL	CL	CL	SCL	<CL	CL	<SCL	<CL	CL	CL	CL	CL	<CL	<CL
20	36	CL	<CL	CL	OL	CL	CL	CL	CL	CL	CL	SCL	< CL	CL	CL	CL	CL	CL	CL
26	36	CL	+++	CL	CL	+++	CL	CL	CL	CL	CL	<CL	CL	CL	CL	CL	CL	SCL	CL

Strain T14		Phages 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**	**10 var 2**	**10 var 3**	**18**
HPA	**36**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**+++**	**++**	**+++**	**OL**	**OL**	**OL**	**OL**
3																				
5	36	SCL	CL	CL	CL	CL	SCL	SCL	CL	OL	CL	SCL	OL	0	0	0	0	0	0	0
10	36	CL	SCL	CL	CL	CL	SCL	CL	CL	CL	CL	CL	CL	+ sm	+ ns	+ ns	OL	OL	<OL	CL
12	36	CL	CL	CL	CL	CL	CL	CL	CL	OL	CL	CL	CL	±	±	±	OL	OL	OL	OL
18	36	<CL	<CL	<<CL	<CL	CL	SCL	<CL	CL	CL	CL	CL	CL	0	0	0	0	0	0	0
20	36	<CL	OL	CL	CL	CL	CL	CL	CL	OL	CL	CL	OL	+++	++	++	OL	OL	SOL	CL
26	36	SCL	CL	CL	CL	CL	<CL	SCL	CL	CL	CL	+++	CL	SCL	++	SCL	OL	OL	<OL	OL

Strain T15		Phages 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	**195**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3																			
5	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	195	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T15		Phages 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**	**10 var 2**	**10 var 3**	**18**
HPA	**195**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**+++**	**-**	**-**	**-**	**-**
3																				
5	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+++	1	1	2	-
10	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	++ sm	+ l	+ n	-	-
12	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	++	±	±	±	-
18	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+++	-1	±	-	-
20	195	0	0	0	0	0	0	0	0	1p	0	0	0	3p	0	++	2p	+/-	0	0
26	195	-	-	-	-	-	-	-	-	-	-	-	-	-	±	+++	±	+	±	-

Strain T16		Phages 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**	**-**	**-**	**-**	**-**	**++**	**-**
3																			
5	104L	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	+	-
10	104 (L)	-	-	-	-	-	-	-	-	-	-	<SCL	<SCL	-	-	-	-	+ sm	-
12	104	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	+	-
18	104L	-	-	-	-	-	-	-	-	-	-	+	SCL	-	-	-	-	±	-
20	104	0	0	0	0	0	0	0	0	0	0	+/-	<CL	0	0	0	0	++	0
26	104	-	-	-	-	-	-	-	-	-	-	++	+++	-	-	-	-	+	-

Strain T16		Phages 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**	**10 var 2**	**10 var 3**	**18**
HPA	**104**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**OL**	**OL**	**OL**	**-**
3																				
5	104L	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0
10	104 (L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	<OL	-
12	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
18	104L	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0
20	104	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<OL	OL	SOL	0
26	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-

Strain T17		Phages 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	**1**	**CL**	**CL**	**CL**	**OL**	**CL**	**CL**	**CL**	**-**	**CL**	**OL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**SCL**	**CL**
3																			
5	1	SCL	SCL	SCL	CL	SCL	CL	SCL	-	SCL	CL	SCL	CL	CL	CL	CL	CL	SCL	CL
10	1	CL	CL	CL	CL	CL	CL	CL	-	CL	CL	CL	CL	CL	CL	CL	CL	<CL	<CL
12	1	CL	CL	CL	CL	CL	CL	CL	-	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
18	1	<CL	<SCL	CL	CL	<CL	CL	CL	-	<CL	CL	<CL	CL	CL	CL	CL	CL	<CL	<CL
20	1	CL	SCL	CL	OL	CL	CL	<CL	0	<CL	CL	<CL	CL	CL	CL	CL	CL	<CL	CL
26	1	SCL	SCL	CL	CL	SCL	CL	CL	-	++	SCL	SCL	CL	CL	CL	CL	CL	SCL	CL

Strain T17		Phages 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**	**10 var 2**	**10 var 3**	**18**
HPA	**1**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**-**	**CL**	**CL**	**OL**	**+++**	**++**	**+++**	**OL**	**OL**	**OL**	**OL**
3																				
5	1	SCL	CL	CL	SCL	SCL	SCL	SCL	CL	-	CL	SCL	OL	0	0	0	0	0	0	0
10	1	CL	<CL	CL	CL	CL	<CL	CL	CL	2 l	CL	CL	CL	++ ns	++ ns	++ ns	OL	OL	<OL	CL
12	1	CL	CL	CL	CL	CL	CL	CL	CL	-	CL	CL	CL	++	++	++	OL	OL	OL	OL
18	1	<CL	<<CL	<CL	<CL	CL	<CL	<CL	CL	-1	CL	CL	CL	0	0	0	0	0	0	0
20	1	<CL	CL	CL	CL	CL	CL	CL	CL	0	CL	CL	OL	++	+	+	OL	OL	<OL	CL
26	1	SCL	CL	CL	SCL	CL	++	SCL	SCL	-	CL	+++	CL	+	+	+	OL	OL	OL	OL

Strain T18		Phages 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**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3																			
5	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	193	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T18		Phages 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**	**10 var 2**	**10 var 3**	**18**
HPA	**193**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**+++**	**+++**	**+++**	**-**	**-**	**-**	**-**
3																				
5	193	0	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
10	193	-	-	-	-	-	-	-	-	-	-	-	-	+++ n	+++ n	+++ n	-	-	-	-
12	193	-	-	-	-	-	-	-	-	-	-	-	-	++	++	++	-	-	-	-
18	193	-	-	-	-	-	-	-	-	-	-	-	-	++	++	SCL	-	-	-	-
20	193	0	0	0	0	0	0	0	0	0	0	0	0	++	SCL	+	0	0	0	0
26	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-

Strain T19		Phages 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	**8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**+++**	**SCL**	**CL**	**-**	**-**	**-**	**-**	**+++**	**-**	**-**	**-**
3																			
5	8	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-	+++	-	-	-
10	8	-	-	-	-	-	-	-	SCL	SCL	SCL	-	-	-	-	+++ ns	-	-	-
12	8	-	-	-	-	-	-	-	SCL	SCL	++	-	-	-	-	+	-	-	-
18	8	-	-	-	-	-	-	-	<SCL	SCL	±	-	-	-	-	±	-	-	-
20	8	0	0	0	0	0	0	0	<CL	SCL	++	0	0	0	0	++	0	0	0
26	8	-	-	-	-	-	-	-	SCL	SCL	+++	-	-	-	-	+++	-	-	-

Strain T19		Phages 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**	**10 var 2**	**10 var 3**	**18**
HPA	**8**	**SCL**	**-**	**SCL**	**SCL**	**-**	**++**	**+**	**-**	**-**	**CL**	**SCL**	**-**	**+**	**+**	**+**	**<OL**	**OL**	**OL**	**-**
3																				
5	8	SCL	-	SCL	SCL	-	-	±	-	-	CL	SCL	-	0	0	0	0	0	0	0
10	8	SCL	-	SCL	SCL	-	-	++ ns	-	-	CL	SCL	-	+ sm	++ sm	++ sm	OL	OL	<OL	-
12	8	++	-	SCL	SCL	-	±	±	-	-	CL	CL	-	±	±	±	OL	OL	OL	-
18	8	±±	-	+	SCL	-	-	-3	-	-	CL	SCL	-	0	0	0	0	0	0	0
20	8	++	0	SOL	<CL	0	+	+	0	0	CL	CL	0	+	+	+	OL	OL	SOL	0
26	8	SCL	-	SCL	SCL	-	-	±	-	-	SCL	+++	-	-	-	-	OL	OL	<OL	-

Strain T20		Phages 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	**40**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**-**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**
3																			
5	40	SCL	SCL	SCL	CL	SCL	CL	SCL	-	SCL	CL	-	CL	CL	CL	CL	SCL	SCL	SCL
10	40	CL	CL	CL	CL	CL	CL	CL	-	CL	CL	-	CL	CL	CL	CL	CL	CL	<CL
12	40	CL	CL	CL	CL	CL	CL	CL	-	CL	CL	-	CL	CL	CL	CL	CL	CL	CL
18	40	<CL	<SCL	CL	CL	SCL	SCL	CL	-1	CL	CL	-	CL	CL	CL	CL	CL	<CL	<CL
20	40	CL	SCL	CL	OL	CL	<CL	CL	1p	CL	<CL	0	CL	CL	CL	CL	CL	<CL	CL
26	40	+++	+++	CL	CL	SCL	CL	SCL	-	+++	SCL	-	CL	CL	CL	SCL	SCL	CL	CL

Strain T20		Phages 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**	**10 var 2**	**10 var 3**	**18**
HPA	**40**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**-**	**CL**	**CL**	**OL**	**+**	**+**	**+**	**OL**	**OL**	**OL**	**OL**
3																				
5	40	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	-	CL	SCL	OL	0	0	0	0	0	0	0
10	40	CL	<CL	CL	CL	CL	<CL	CL	CL	1 l	CL	CL	CL	++ ns	+++ ns	++ ns	OL	OL	<OL	CL
12	40	CL	CL	CL	CL	CL	CL	CL	CL	-	CL	CL	CL	±	±	±	OL	OL	OL	OL
18	40	SCL	<CL	SCL	<CL	CL	<CL	<CL	CL	-	CL	CL	CL	0	0	0	0	0	0	0
20	40	<CL	CL	<CL	CL	CL	CL	CL	<CL	1p	CL	CL	OL	2p	++	+/-	OL	OL	SOL	CL
26	40	SCL	CL	SCL	CL	CL	+++	SCL	CL	-	CL	SCL	CL	+	+	+	OL	OL	OL	OL

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