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Article *in* Research in Microbiology · September 2014

DOI: 10.1016/j.resmic.2014.07.004

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Supplement 2008–2010 (no. 48) to the White–Kauffmann–Le Minor scheme☆

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Received 4 July 2014; accepted 6 July 2014
Available online 15 July 2014

Abstract

This supplement (no. 48) of the White–Kauffmann–Le Minor scheme reports on the characterization of 63 new *Salmonella* serovars and 25 new variants of previously described *Salmonella* serovars recognized by the WHO Collaborating Centre for Reference and Research on *Salmonella* between 2008 and 2010. Forty-four new serovars were assigned to *Salmonella enterica* subspecies *enterica*, 12 to subspecies *salamae*, two to subspecies *arizonae*, two to subspecies *diarizonae* and three to subspecies *houtenae*. All these new serovars or new variants are described with their multilocus sequence type.

Keywords: *Salmonella*; Serovars; Taxonomy; MLST; White–Kauffmann–Le Minor scheme

The genus *Salmonella* consists of only two species, *Salmonella enterica* and *Salmonella bongori*. *S. enterica* is divided into six subspecies: *S. enterica* subsp. *enterica*, *S. enterica* subsp. *salamae*, *S. enterica* subsp. *arizonae*, *S. enterica* subsp. *diarizonae*, *S. enterica* subsp. *houtenae*, and *S. enterica* subsp. *indica.* This nomenclature reflects present understanding of *Salmonella* taxonomy [1,2]. The species called *Salmonella subterranea* [3] does not belong in the genus *Salmonella* (Table 1, Fig. 1).

Serovars belonging to *S. enterica* subsp. *enterica* are typically designated by a name usually related to the geographical place where the serovar was first isolated [7]. The serovar name is written in non-italicized Roman letters and the first letter capitalized. Serovars belonging to other subspecies are designated by their antigenic formulae, following the subspecies name. The antigenic formulae of *Salmonella* serovars are available in the White–Kauffmann–Le Minor scheme [7] at: http://www.pasteur.fr/sante/clre/cadrecnr/salmoms/WKLM_En.pdf

Updating this scheme is the responsibility of the WHO Collaborating Centre for Reference and Research on *Salmonella* (WHO-Salm), Institut Pasteur, Paris, France. The current edition (9th) issued in 2007 comprises antigenic formulae validated as of January 1st 2007. In 2010, Supplement 47 reported the characterization of 70 new *Salmonella* serovars recognized between January 1st 2003 and December 31st 2007 [8].

☆ In memory of Prof. Michel-Yvan Popoff (1945–2013) who headed the WHO Collaborating Centre for Reference and Research on *Salmonella* at the Pasteur Institute between 1989 and 2003.

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http://dx.doi.org/10.1016/j.resmic.2014.07.004

Table 1
Atypical characteristics of the reference strain of "*Salmonella subterranea*" (strain CIP109002).

	Strain CIP109002
Biochemical tests[a]	Indole$^+$, citrate$^-$, LDC$^-$, H2S$^-$
Serotyping[b]	No agglutination
rpoB sequencing[c]	Not clustered with *Salmonella* strains
MLST[d]	Not typable

[a] This strain was not pigmented in yellow in classical culture media as described by the authors.
[b] Performed with antisera produced according to reference 4.
[c] See Fig. 1.
[d] Performed according to reference 6. More than 2300 strains belonging to >650 serotypes of *S. enterica* subsp. *enterica* ($n = 1765$), *salamae* ($n = 227$), *arizonae* ($n = 51$), *diarizonae* ($n = 165$), *houtenae* ($n = 63$), *indica* ($n = 15$), and *S. bongori* ($n = 31$) have been MLST typed at the WHO-CC without encountering not typable *Salmonella* strains.

Supplement 48 reports the characterization of 63 new *Salmonella* serovars recognized between January 1st 2008 and December 31st 2010 by the WHO-Salm: 44 were assigned to *S. enterica* subsp. *enterica*, 12 to subsp. *salamae*, two to subsp. *arizonae*, two to subsp. *diarizonae* and three to subspecies *houtenae* (Table 2).

It is useful to note that strain 9736/07, erroneously described in the Supplement 47 [8] as the reference strain of *S. bongori* serovar 1,9,12:d:e,n,x has been reassigned to *S. enterica* subsp. *enterica* on the basis of its biochemical characteristics, its diphasic nature, *rpoB* sequence (Fig. 1), and multilocus sequence type [6]. This strain is now considered as the reference strain of the new serovar Viikki.

Among the 63 new serovars identified, 21 were received from the Gastrointestinal Bacteria Reference Unit of Public Health England (PHE), Colindale, UK. These 21 new serovars were isolated between 1994 and 2004 and correspond to all potential new serovars identified at PHE during this period.

New variants of previously described *Salmonella* serovars are provided in Table 3

For the first time, the multilocus sequence type has been indicated for all the 63 new serovars as well as for the 25 new variants of previously described *Salmonella* serovars. Multilocus sequence typing (MLST) has been performed both at the WHO-CC or at the PHE according to Achtman et al. [6]. The data have been submitted to the *S. enterica* MLST database (http://mlst.warwick.ac.uk/mlst/dbs/Senterica).

The present number of serovars per species and subspecies is given in Table 4.

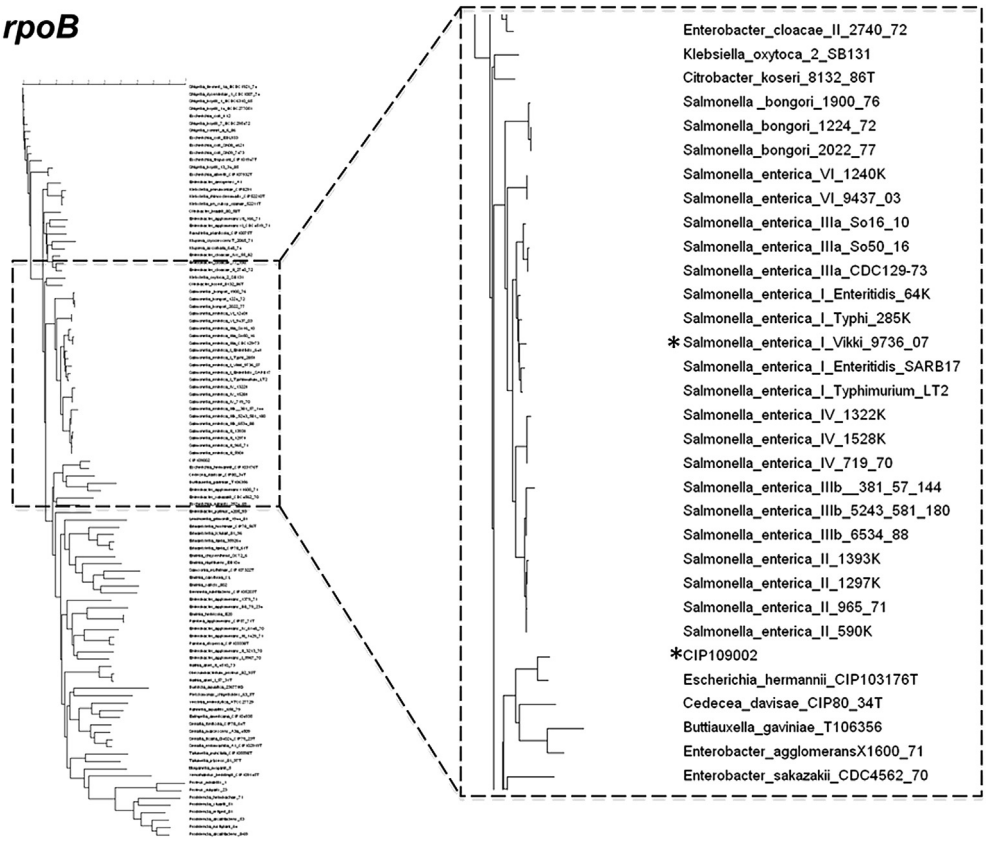

Fig. 1. Phylogenetic analysis of partial *rpoB* sequences of 103 strains of Enterobacteriaceae, including strains 9736/07 and CIP109002. The analysis was done by the neighbour-joining method using BioNumerics version 6.6 software package (Applied Maths, Sint-Martens-Latem, Belgium). The partial *rpoB* sequences (about 1000 bp) were obtained by PCR using primers VIC4 (5′GGCGAAATGGCDGARAACCA-3′) and VIC6 (5′-GGTTACAACTTCGARGAYTC-3′) with conditions (annealing at 50 °C) described previously [5]. The different *S. enterica* subspecies are indicated by symbols, I (subsp. *enterica*), II (subsp. *salamae*), IIIa (subsp. *arizonae*), IIIb (subsp. *diarizonae*), IV (subsp. *houtenae*), and VI (subsp. *indica*). The strains 9736/07 and CIP109002 are indicated with an asterisk.

Table 2
New *Salmonella* serovars recognized by the WHO Collaborating Centre for Reference and Research on *Salmonella*, 2008–2010.

Serovar name	Antigenic formula	Other characters[b]	Source	Area of isolation (or contamination)	Year	IP strain number	Received from[c]	MLST type
Salmonella enterica* subsp. *enterica								
Viikki[a]	1,9,12:d:e,n,x	ONPG$^+$, Gal$^+$	Cattle	Finland	2007	9736/07	NPHI	ST1743
Bruxelles	41:y:–		Spice	Belgium	2007	9764/08	ISSP	ST1735
Forges	47:z_4,z_{23}:1,2		Human feces	France	2007	9765/08	IP	ST1700
Trumersee	1,6,14,25:k:e,n,x		Rosemary herb	Austria	2008	9789/08	IMED	ST1701
Pajala	13,23:z_{41}:e,n,z_{15}		Bird	Sweden	2008	9806/08	SMI	ST1704
Chapuri	13,23:i:z_6		Human feces	USA	2007	9811/08	CDC	ST1705
Baltimore	35:y:l,w		Human feces	USA	2008	9812/08	CDC	ST1706
Landeskrone	39:–:1,6		Human	Germany	2007	9814/08	IHU	ST1707
Rosslyn	51:y:1,2		Snake	Niger	2008	9817/08	PHAC	ST1708
Kakikoka	30:b:z_6		Human feces	Benin	2008	9829/08	RKI	ST627
Parabiago	28:c:l,w		Human feces	Italy	2008	9837/08	ISS	ST1709
Durance	13,22:z:z_6		Human feces	France	2008	9843/08	IP	ST1710
Santaclara	3,10:z_{35}:1,5	Mal$^+$, Sal$^+$, Gal$^+$	Human feces	USA	2007	9847/08	CDC	ST1711
Capetown	3,15,34:y:1,6	Dtar$^-$, Gal$^+$	Human feces	USA	2008	9848/08	CDC	ST1712
Fortbend	1,3,19:z_{41}:e,n,z_{15}		Human feces	USA	2008	9850/08	CDC	ST1713
Mali	51:r:e,n,x		Human	Germany (West Africa)	2009	9879/09	RKI	ST1714
Bergerac	44:c:e,n,x		Human feces	France (Guinea)	2009	9970/09	IP	ST1715
Salpetriere	21:k:1,6		Human feces	France	2009	9992/09	IP	ST1716
Wembleypark	17:g,m:–	H2S$^-$	Human feces	UK	1994	9997/09	PHE	ST1761
Noho	13,23:k:1,6		Human feces	UK	1996	9999/09	PHE	ST1762
Ashford	6,7:k:z_{35}	ONPG$^+$	Spice	UK	1996	10000/09	PHE	ST1760
Elmdon	51:i:1,2		Human feces	UK	1996	10002/09	PHE	ST1763
Torbay	3,10:l,z_{28}:1,5		Human feces	UK (Gambia)	1997	10004/09	PHE	ST1764
Colchester	8,20:r:1,6		Sausage	UK	1997	10005/09	PHE	ST1765
Sandbanks	6,8:k:1,7		Human feces	UK	1997	10006/09	PHE	ST1766
Cork	9,46:y:1,2		Sausage	Republic of Ireland	1998	10008/09	PHE	ST1767
Frimley	39:r:1,5		Human feces	UK (Nigeria)	1999	10010/09	PHE	ST1769
Harrow	4,12:z_{10}:1,7		Human feces	UK	1999	10011/09	PHE	ST1811
Goodmayes	44:z:e,n,z_{15}		Human feces	UK	1999	10012/09	PHE	ST1770
Poole	9,46:a:1,6		Human feces	UK (East Africa)	2001	10017/09	PHE	ST1773
Kingslynn	3,10:z:e,n,z_{15}		Human feces	UK (Gambia)	2004	10018/09	PHE	ST877
Maybush	11:z:e,n,z_{15}		Human feces	UK	2004	10019/09	PHE	ST878
Carshalton	47:g,m,s:–		Human feces	UK (Nigeria)	2004	10020/09	PHE	ST1774
Stafford	6,14,24:z:l,z_{13},z_{28}		Human feces	UK	2004	10023/09	PHE	ST557
Coppettswood	30:b:l,z_{13},z_{28}		Human feces	UK (Ghana)	2004	10024/09	PHE	ST1775
Welwyn	11:l,z_{13},z_{28}:e,n,z_{15}		Dried ugu leaves	UK	2004	10026/09	PHE	ST887
Zollikerberg	6,7:z_4,z_{24}:1,5		Human feces	Switzerland	2007	10031/09	IFSH	ST1717
Yverdon	1,4,12:z_{38}:1,5		Human feces	Switzerland (Burkina Faso)	2009	10033/09	IFSH	ST1718
Nuorikkala	8:z_4,z_{24}:e,n,x		Feed factory environment	Finland	2010	10084/10	NPHI	ST1719
Gostenhof	1,42:d:z_6		Human feces	Germany	2009	10085/10	IHU	ST1720
Owerri	6,14,25:l,z_{13},z_{28}:1,6		Human feces	Norway (Nigeria)	2010	10105/10	NIPH	ST1721
Braeswood	47:c:z_6		Human feces	USA	2009	10113/10	CDC	ST1722
Saintes	13,23:d:e,n,x		Human feces	France (Guinea)	2010	10142/10	IP	ST1723
Perrosguirec	4,12:z_4,z_{23}:e,n,z_{15}		Human feces	France (Cote d'Ivoire)	2010	10146/10	IP	ST1724
subsp. *salamae*								
	3,15:z_{87}:e,n,x,z_{15}	Sal$^+$, ONPG$^+$	Reptile	Germany	2007	9822/08	BfR	ST1349
	11:z_{41}:e,n,x	ONPG$^+$	Chamaeleon	Germany	2008	9827/08	BfR	ST1365
	3,10:a:z_{87}		Human feces	USA	2008	9849/08	CDC	ST1348
	9,12:g,m,t:z_{39}		Tea leaves	Germany	2008	9880/09	IHU	ST1725
	13,23:g,s,t:e,n,x		Human	Germany	2009	9944/09	IHU	ST1726
	17:d:z_6	Dul$^-$	Human	Germany	2009	9991/09	RKI	ST1727
	6,7:z:e,n,x,z_{15}		Spice	France	2009	9994/09	IP	ST1728
	35:g,z_{62}:e,n,x		Human feces	UK	1994	9996/09	PHE	ST1812
	6,7:b:1,5		Human feces	UK	2000	10014/09	PHE	ST1772
	13,22:g,m,t:z_{42}		Human feces	UK	2001	10016/09	PHE	ST1813
	1,9,12,46,27:b:z_{39}		Lizard	Germany	2010	10090/10	BfR	ST1729
	43:m,t:–	ONPG$^+$	Chamaeleon	Germany	2010	10134/10	BfR	ST1730
subsp. *arizonae*								
	51:z_{36}:–		Human sputum	USA	2008	9813/08	CDC	ST1414
	17:g,z_{51}:–		Bobcat lung	USA	2007	9846/08	CDC	ST1375

Table 2 (*continued*)

Serovar name	Antigenic formula	Other characters[b]	Source	Area of isolation (or contamination)	Year	IP strain number	Received from[c]	MLST type
subsp. *diarizonae*								
	48:k:z_{57}		Human	Poland	2007	9785/08	MUG	ST1731
	11:i:z		River	USA	2007	9809/08	CDC	ST1265
subsp. *houtenae*								
	30:g,m,t,z_{51}:−[d]	Sal^-	Sea water	Bolivia	1978	2193/78	INLASA	ST1200
	48:z_4,z_{24}:−		Human feces	USA	2007	9810/08	CDC	ST1732
	21:z_{38}:−		Toucan bird	Brazil	2008	9828/08	BfR	ST1733

[a] Serovar previously described as belonging to *S. bongori* in Supplement 47 of the White–Kauffman–Le Minor scheme [8] but reassigned to *S. enterica* subsp. *enterica.*

[b] The differential phenotypical characters of *Salmonella* species and subspecies are indicated in reference 7. Only the atypical results are mentioned. Tests used : β-galactosidase, ONPG; galacturonate, Gal; malonate, Mal; salicin, Sal; dulcitol, Dul; L(+) tartrate (=*d*-tartrate), Dtar; hydrogen sulfide, H2S. +, positive reaction; −, negative reaction.

[c] The National Reference Centres that sent the isolates are indicated in the acknowledgments section.

[d] The reactivity to H:m and H:t factors depends on the brand of the antisera. The gelatinase test might be lately positive (5 days) or negative.

Table 3
New variants of previously described *Salmonella* serovars recognized by the WHO Collaborating Centre for Reference and Research on *Salmonella*, 2008–2010.

IP strain number	Antigenic formula	Other character[a]	Source	Area of contamination or isolation	Year	Received from[b]	Serovar name	MLST type	Updated antigenic formula
S. enterica* subsp. *enterica									
9763/08	1,13,23:z_4,z_{23}:−		Human feces	France	2008	IP	Ajiobo	ST1065	1,13,23:z_4,z_{23}:−
9766/08	3,10:g,s,t:−:Rz_{27}		Poultry environment	La Réunion[c]	2008	IP	Westhampton	ST185	3,{10}{15}{15,34}:g,s,t:−:[Rz_{27}], [Rz_{37}]
9768/08	1,4,5,12:z:1,2		Human feces	France	2007	IP	Shubra	ST1394	1,4,[5],12:z:1,2
9815/08	6,14,25:k:e,n,x		Rosemary herb	Germany	2008	IHU	Trumersee	ST1701	1,6,14,25:k:e,n,x
9838/08	45:m,t:−:Rz_{45}		Poultry	Senegal	2008	IP	Apapa	ST1049	45:m,t:−:[Rz_{45}]
9957/09	1,3,19:d:l,w:Rz_{45}		Environment	France	2009	IP	Tilburg	ST1736	1,3,19:d:l,w:[Rz_{45}], [Rz_{49}]
9959/09	4,12:b:e,n,z_{15}		Human feces	France	2009	IP	Wagenia	ST1667	1,4,12,[27]:b:e,n,z_{15}
10035/09	4,5,12:i:e,n,x	$Dtar^-$, Gas^-	Poultry environment	France	2009	IP	Farsta	ST886	4,[5],12:i:e,n,x
10087/10	3,15,34:d:e,n,x		Horn	Germany	2010	RKI	Souza	ST1737	3,{10}{15}{15,34}:d:e,n,x
10088/10	35:z_{29}:−:Rz_{58}		Lizard	Germany (Ghana)	2010	BfR	Widemarsch	ST1739	35:z_{29}:−:[Rz_{58}]
10104/10	6,7:g,m,s:−:Rz_{82}		Poultry environment	Mayotte	2009	IP	Montevideo	ST195	{6,7,14},{54}:g,m,[p],s:[1,2,7]:[Rz_{82}]
10110/10	1,4,12,27:l,v:e,n,z_{15}		Human feces	France	2010	IP	Brandenburg	ST241	1,4,[5],12,[27]:l,v:e,n,z_{15}
S. enterica* subsp. *salamae									
10007/09	35:m,t:e,n,x		Human feces	UK	1997	PHE		ST1642	35:m,t:[e,n,x]
10036/09	30:g,t:1,5		Human	Germany	2009	IHU		ST1466	30:g,t:[1,5]
10089/10	9,12:b:e,n,x		Reptile	Germany	2010	BfR		ST1843	1,9,12:b:e,n,x[d]
10106/10	1,40:z_{10}:e,n,x	$ONPG^+$	Chameleon	Germany	2010	RKI		ST1636	1,40:z_{10}:e,n,x
S. enterica* subsp. *diarizonae									
9780/08	47:c:e,n,x,z_{15}:Rz_{84}		Snake	Canada	2007	PHAC			47:c:e,n,x,z15: [Rz_{57}], [Rz_{84}]
9874/09	48: l,v:1,5,7:Rz_{90}		Reptile	Germany	2009	BfR			48:l,v:1,5,(7): [Rz_{47}], [Rz_{50}], [Rz_{70}], [Rz_{89}], [Rz_{90}]
9965/09	47:r:z:Rz_{50}		Human feces	Korea	2009	KCDC			47:r:z:[Rz_{50}]
9973/09	60:r:e,n,x,z_{15}:Rz_{55}		Snake	Germany	2009	BfR			60:r:e,n,x,z_{15}:[Rz_{55}]
9974/09	61:i:z:Rz_{54}		Snake	Germany	2009	BfR			61:i:z:[Rz_{54}]
9993/09	48:r:z:Rz_{50}		Poultry environment	La Réunion[c]	2009	IP			48:r:z:[Rz_{50}]
10028/09	(6),14:z_{10}:z:Rz_{57}		Poultry	France	2009	IP			(6),14:z_{10}:z:[Rz_{56}], [Rz_{57}], [Rz_{90}]
10082/10	38:k:z_{35}:z_{65}		Human feces	Finland	2010	NPHI			38:k:z_{35}:[z_{65}]
10112/10	48:l,v:1,5,7:Rz_{70}		Snake	USA	2009	CDC			48:l,v:1,5,(7): [Rz_{47}], [Rz_{50}], [Rz_{70}], [Rz_{89}], [Rz_{90}]

[a] The differential phenotypical characters of *Salmonella* species and subspecies are indicated in reference 7. Only the atypical results are mentioned. Tests used : Gas production from glucose, Gas; β-galactosidase, ONPG; L(+) tartrate (=*d*-tartrate), Dtar; +, positive reaction; −, negative reaction.

[b] The National Reference Centres that sent the isolates are indicated in the acknowledgments section.

[c] French island in the Indian Ocean.

[d] This antigenic formula was erroneously mentioned in the 9th edition of the White–Kauffmann–Le Minor scheme.

Table 4
Present number of serovars in each species and subspecies of *Salmonella*.

S. enterica	*n*
subsp. *enterica*	1586
subsp. *salamae*	522
subsp. *arizonae*	102
subsp. *diarizonae*	338
subsp. *houtenae*	76
subsp. *indica*	13
S. bongori	22
Total	2659

The next issue of the White–Kauffmann–Le Minor scheme, which will contain MLST data, is expected in December 2015.

Acknowledgements

We thank P. Dunker (Institut für Hygiene and Umwelt), S. Simington (CDC), and M.S. Van Duyne (CDC), J. Bale (PHE) and D. Meunier (PHE) for their technical assistance.

We thank all the National Reference Centres that sent the new serovars or variants to the WHO-Salm: Institut für Medizinische Mikrobiologie und Hygiene (IMED), Graz, Austria (C. Kornschober); Institut scientifique de Santé Publique (ISSP), Brussels, Belgium (S. Bertrand); Institut National des Laboratoires de la Santé (INLASA), La Paz, Bolivia (R.M. Ruiz); Public Health Agency of Canada (PHAC), Winnipeg, Canada (H. Tabor), Korean CDC (KCDC), Seoul, South Korea (D-Y. Lee); National Public Health Institute (NPHI), Helsinki, Finland (S. Lukinmaa & A. Siitonen); Institut Pasteur (IP), Paris, France (F.-X. Weill & S. Le Hello); Federal Institute for Risk Assessment (BfR), Berlin, Germany (I. Szabo & C. Dorn); Institut für Hygiene and Umwelt (IHU), Hamburg, Germany (P. Roggentin); Robert Koch Institute (RKI), Wernigerode, (W. Rabsch); Istituto Superiore di Sanità (ISS), Roma, Italy (I. Luzzi); Norwegian Institute of Public Health (NIPH), Oslo, Norway (J. Lassen & A.-L. Wester); Medical University of Gdansk (MUG), Gdansk, Poland (D. Kunikowska); Swedish Institute for Infectious Disease Control (SMI), Solna, Sweden (R. Wollin); Institute for Food Safety and Hygiene (IFSH), Zürich, Switzerland (H. Hächler); Public Health England (PHE), Colindale, UK (E. de Pinna); Centers for Disease Control and Prevention (CDC), Atlanta, USA (M. Mikoleit & P.I. Fields).

References

[1] Judicial Commission. The type species of the genus *Salmonella* Lignieres 1900 is *Salmonella enterica* (*ex* Kauffmann and Edwards 1952) Le Minor and Popoff 1987, with the type strain LT2^T, and conservation of the epithet *enterica* in *Salmonella enterica* over all earlier epithets that may be applied to this species. Opinion 80. Int J Syst Evol Microbiol 2005;55:519–20.

[2] Tindall BJ, Grimont PAD, Garrity GM, Euzeby JP. Nomenclature and taxonomy of the genus S*almonella*. Int J Syst Evol Microbiol 2005;55:521–4.

[3] Shelobolina ES, Sullivan SA, O'Neill KR, Nevin KP, Lovley DR. Isolation, characterization, and U(VI)-reducing potential of a facultatively anaerobic, acid-resistant bacterium from low-pH, nitrate- and U(VI)-contaminated subsurface sediment and description of *Salmonella subterranea* sp. nov. Appl Environ Microbiol 2004;70:2959–65.

[4] Popoff MY. Guidelines for the preparation of *Salmonella* antisera. 6th Revision. Paris: WHO Collaborating Centre for Reference and Research on *Salmonella*, Institut Pasteur; 2001.

[5] Ait Tayeb L, Ageron E, Grimont F, Grimont PA. Molecular phylogeny of the genus Pseudomonas based on *rpoB* sequences and application for the identification of isolates. Res Microbiol 2005;156:763–73.

[6] Achtman M, Wain J, Weill FX, Nair S, Zhou Z, Sangal V, et al., *S. enterica* MLST Study Group. Multilocus sequence typing as a replacement for serotyping in *Salmonella* enterica. PLoS Pathog 2012;8:e1002776.

[7] Grimont PAD, Weill FX. Antigenic formulae of the *Salmonella* serovars. 9th ed. Paris: WHO Collaborating Centre for Reference and Research on *Salmonella*, Institut Pasteur; 2007. Available at:http://www.pasteur.fr/sante/clre/cadrecnr/salmoms/WKLM_En.pdf.

[8] Guibourdenche M, Roggentin P, Mikoleit M, Fields PI, Bockemühl J, Grimont PA, et al. Supplement 2003-2007 (No. 47) to the White-Kauffmann-Le Minor scheme. Res Microbiol 2010;161:26–9.