

## Supplement 2003–2007 (No. 47) to the White-Kauffmann-Le Minor scheme

Martine Guibourdenche, Peter Roggentin, Matthew Mikoleit, Patricia Fields,  
Jochen Bockemühl, Patrick Grimont, François-Xavier Weill

► **To cite this version:**

Martine Guibourdenche, Peter Roggentin, Matthew Mikoleit, Patricia Fields, Jochen Bockemühl, et al.. Supplement 2003–2007 (No. 47) to the White-Kauffmann-Le Minor scheme. Research in Microbiology, Elsevier, 2010, 161 (1), pp.26-29. 10.1016/j.resmic.2009.10.002 . pasteur-02019334

**HAL Id: pasteur-02019334**

**<https://hal-pasteur.archives-ouvertes.fr/pasteur-02019334>**

Submitted on 11 Mar 2019

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



1

2 **Supplement 2003-2007 (no. 47) to the White-Kauffmann-Le Minor scheme**

3

4

5 Martine Guibourdenche<sup>a</sup>, Peter Roggentin<sup>b</sup>, Matthew Mikoleit<sup>c</sup>, Patricia I.  
6 Fields<sup>c</sup>, Jochen Bockemühl<sup>b</sup>, Patrick A.D. Grimont<sup>a</sup>, François-Xavier Weill<sup>a\*</sup>

7

8

9 <sup>a</sup> Institut Pasteur, WHO Collaborating Centre for Reference and Research on *Salmonella*,  
10 Unité de Biodiversité des Bactéries Pathogènes Emergentes, Paris, France

11

12 <sup>b</sup> Salmonella-Zentrale, Institut für Hygiene und Umwelt, Hamburg, Germany

13

14 <sup>c</sup> Centers for Disease Control and Prevention, Atlanta, Georgia, USA

15

16

17 \* Corresponding author

18 WHO Collaborating Centre for Reference and Research on *Salmonella*, Laboratoire des

19 Bactéries Pathogènes Entériques, Institut Pasteur, 28 rue du Docteur Roux, 75724 Paris cedex

20 15, France. Tel: 33-(0)1 45 68 83 45. Fax: 33-(0)1 45 68 88 37. Email: fxweill@pasteur.fr

## 1 **Abstract**

2 This supplement reports the characterization of 70 new *Salmonella* serovars recognized  
3 between 2003 and 2007 by the WHO Collaborating Centre for Reference and Research on  
4 *Salmonella*: 44 were assigned to *Salmonella enterica* subspecies *enterica*, 11 to subspecies  
5 *salamae*, 5 to subspecies *arizonae*, 8 to subspecies *diarizonae*, one to subspecies *houtenae*  
6 and one to *S. bongori*. One new serovar, Mygdal, displayed a new H factor, H:z<sub>91</sub>.

7

8 *Key words*: *Salmonella*; Serovars; Taxonomy; White-Kauffmann-Le Minor scheme

9

10

## 1 **1. Introduction**

2           The genus *Salmonella* consists of only two species, *Salmonella enterica* and *S.*  
3 *bongori*. *S. enterica* is divided into six subspecies: *S. enterica* subsp. *enterica*, *S. enterica*  
4 subsp. *salamae*, *S. enterica* subsp. *arizonae*, *S. enterica* subsp. *diarizonae*, *S. enterica* subsp.  
5 *houtenae*, and *S. enterica* subsp. *indica*; and. This nomenclature reflects present  
6 understanding of *Salmonella* taxonomy [1, 4]. Serovars belonging to *S. enterica* subsp.  
7 *enterica* are typically designated by a name usually related to the geographical place where the  
8 serovar was first isolated. The serovar name is written in non-italicized Roman letters and the  
9 first letter capitalized. Serovars belonging to other subspecies are designated by their antigenic  
10 formulae, following the subspecies name. The antigenic formulae of *Salmonella* serovars are  
11 listed in a document called the White-Kauffmann-Le Minor scheme [3]. Updating this scheme  
12 is the responsibility of the WHO Collaborating Centre for Reference and Research on  
13 *Salmonella* (WHO-Salm), Institut Pasteur, Paris, France. The current edition (9th) issued in  
14 2007 comprises antigenic formulae validated as of January 1st 2007.

15       Supplement 47 reports the characterization of 70 new *Salmonella* serovars recognized  
16 between 2003 and 2007 by the WHO-Salm: 44 were assigned to *S. enterica* subsp. *enterica*,  
17 11 to subspecies *salamae*, 5 to subsp. *arizonae*, 8 to subsp. *diarizonae*, one to subspecies  
18 *houtenae*, and one to *S. bongori* (Table 1). Variants of previously described serovars are  
19 provided in Table 2. The present number of serovars per species and subspecies is given in

1 Table 3.

2 The strain 1357K (strain 9744/07) (Table 1), originally described by Kauffmann as the  
3 reference strain of *S. enterica* subsp. *enterica* serovar Hisingen (48:a:1,5,7), was recently  
4 found to be *S. enterica* subsp. *salamae* serovar 48:z<sub>81</sub>:1,5,7. Consequently the serovar  
5 Hisingen will be withdrawn in the next issue of the White-Kauffmann-Le Minor scheme.

6 Additionally, a new H factor, H:z<sub>91</sub>, was identified in one new serovar, *S. enterica* serovar  
7 Mygdal (strain 9398/03) (Table 1). A partial sequence (1250 bp) of the *fliC* gene encoding  
8 H:z<sub>91</sub> has been submitted to GenBank (accession number GQ280905). The *fliC* allele  
9 encoding H:z<sub>91</sub> was related to alleles encoding H:b. Antiserum to H:z<sub>91</sub> was prepared  
10 following WHO-Salm guidelines [2]. Briefly, rabbits were immunized using strain 9398/03.  
11 The crude antiserum (diluted 1:5) was successively absorbed with a boiled culture of strain  
12 9398/03 to remove O agglutinins. Absorbtion with formalin-treated cultures of serovar Wien  
13 strain 320K (H:b) and serovar Ohio strain CDC 1115-874/64 (H:b) were then performed to  
14 remove cross-reactions with the H:b antigen. This absorbed antiserum agglutinated only the  
15 motile culture of strain 9398/03.

16

17

### **Acknowledgements**

18 We thank C. Fayolle (Institut Pasteur), S. Plavsic (Institut für Hygiene and Umwelt), P.  
19 Dunker (Institut für Hygiene and Umwelt), L. Gheesling (CDC), S. Simington (CDC), and

1 M.S. Van Duyne (CDC) for their technical assistance.

2

3 We thank all the National Reference Centres that have sent the new serovars or variants to  
4 the WHO-Salm:

5

6 **Austria :**

7 -Institut für Medizinische Mikrobiologie (IMED), Graz (C. Kornschober)

8 **Belgium :**

9 -Institut Scientifique de Santé Publique, Brussels (S. Bertrand and J.M.  
10 Collard).

11 **Canada :**

12 -National Microbiology Laboratory (NML), Winnipeg (D. Woodward and H.  
13 Tabor).

14 -Laboratory for Foodborne Zoonoses (LFZ), Guelph (A. Muckle).

15 **Denmark :**

16 -Statens Serum Institute (SSI), Copenhagen (J. Sonne-Hansen).

17 **Finland :**

18 -National Public Health Institute (NPHI), Helsinki (S. Lukinmaa and A.  
19 Siitonen).

20 **France :**

21 -Institut Pasteur (IP), Paris (F.-X. Weill and P.A.D. Grimont).

22 **Germany :**

23 -Federal Institute for Risk Assessment (BfR), Berlin (A. Schroeter and C.  
24 Dorn).

25 -Institut für Hygiene und Umwelt (IHU), Hamburg (J. Bockemühl and P.  
26 Roggentin).

27 -Robert Koch Institute (RKI), Wernigerode (W. Rabsch).

28 **Ireland :**

- 1 -National University of Ireland (NUI), Galway (N. De Lappe and M.  
2 Cormican).
- 3 **Israel :**
- 4 -Government Central Laboratories (GCL), Jerusalem (A. Reisfeld)
- 5 **New Zealand :**
- 6 -Institute of Environmental Science and Research Limited (ESR), Porirua (D.  
7 Duncan).
- 8 **Norway :**
- 9 -Norwegian Institute of Public Health (NIPH), Oslo (J. Lassen)
- 10
- 11 **Senegal:**
- 12 -Institut Pasteur de Dakar (IPD), Dakar (J.-D. Perrier-Gros-Claude and B.  
13 Garin).
- 14 **Sweden :**
- 15 -Swedish Institute for Infectious Disease Control (SIIDC), Solna (R. Wollin).
- 16 **Switzerland :**
- 17 -Institut de Bactériologie Vétérinaire (IBV), Bern (H. Hächler)
- 18 **Thailand :**
- 19 -National Institute of Health (TNIH), Nonthaburi (P. Sawanpanyalert).
- 20 **USA**
- 21 -Centers for Disease Control and Prevention (CDC), Atlanta (P.I. Fields)
- 22
- 23
- 24
- 25
- 26

## References

- 1
- 2 [1] Judicial Commission, The type species of the genus *salmonella* Lignieres 1900 is
- 3 *Salmonella enterica* (ex Kauffmann and Edwards 1952) Le Minor and Popoff 1987, with
- 4 the type strain LT2<sup>T</sup>, and conservation of the epithet *enterica* in *Salmonella enterica*
- 5 over all earlier epithets that may be applied to this species. Opinion 80, Int. J. Syst. Evol.
- 6 Microbiol. 55 (2005) 519-520.
- 7 [2] Popoff M.Y., Guidelines for the preparation of *Salmonella* antisera, 6<sup>th</sup> revision, WHO
- 8 Collaborating Centre for Reference and Research on *Salmonella*, Institut Pasteur, Paris,
- 9 2001.
- 10 [3] Grimont P.A.D, Weill F.-X., Antigenic formulae of the *Salmonella* serovars, 9th edition,
- 11 WHO Collaborating Centre for Reference and Research on *Salmonella*, Institut Pasteur,
- 12 Paris, 2007. Available at :
- 13 [http://www.pasteur.fr/sante/clre/cadreocr/salmoms/WKLM\\_En.pdf](http://www.pasteur.fr/sante/clre/cadreocr/salmoms/WKLM_En.pdf)
- 14 [4] Tindall B.J., Grimont P.A.D., Garrity G.M., Euzéby J.P. Nomenclature and taxonomy of
- 15 the genus *Salmonella*, Int. J. Syst. Evol. Microbiol. 55 (2005) 521-524.
- 16
- 17
- 18
- 19



1 **Table 1.** New *Salmonella* serovars recognized by the WHO Collaborating Centre for  
 2 Reference and Research on *Salmonella*, 2003-2007.

3

Serovar name	Antigenic formula	Other characters <sup>c</sup>	Source	Area of contamination or isolation	Year	IP strain number	Received from <sup>d</sup>
<b><i>Salmonella enterica</i></b>							
<b>subsp. <i>enterica</i></b>							
Korkeasaari	28:e,h:1,5		Lizard	Africa	2003	9370/03	NPHI
Moabit	16:e,h:l,w		Melon kernel Meal	Germany	2003	9374/03	BfR
Kaevlinge	16:z <sub>4</sub> ,z <sub>24</sub> :-		Environment	Sweden	2002	9375/03	SIIDC
Mygdal	4,12:z <sub>91</sub> :-		Swine faeces	Denmark	2003	9398/03	SSI
Epalinges	43:l,w:-	01-	Environment	Switzerland	2003	9428/03	IBV
Farmingdale	43:z <sub>4</sub> ,z <sub>23</sub> :-		Lizard	USA	2003	9447/03	CDC
Amberg	6,14,24:l,v:1,7		Caraway seed	Germany	2003	9455/03	BfR
Sally	41:z:1,6		Beef meat	Senegal	2003	9460/03	IP/IPD
Evry	35:i:z <sub>6</sub>	Tar-	Human stools	France	2003	9462/03	IP
Albertbanjul	44:r:1,5	01-	Meat	Senegal	2003	9475/04	IP/IPD
Martonos	6,14,24:d:1,5		Parsley	Serbia	2004	9485/04	IHU
Gueuletapee	9,12:g,m,s:-		Chicken	Senegal	2004	9489/04	IP
Lamphun	6,8:y:1,2		Animal feed	Thailand	2003	9491/04	TNIH
Parakou	1,42:l,w:z <sub>35</sub>		Water	Africa	2004	9495/04	IHU
Hohentwiel	30:z:e,n,x,z <sub>15</sub>		Paprika powder	Germany	2004	9497/04	IHU
Carpentras	38:z <sub>35</sub> :e,n,z <sub>15</sub>		Seed	France	2004	9500/04	IP
Lund	6,8:l,v:z <sub>6</sub>		Human stools	Sweden	2003	9502/04	SIIDC
Willamette	38:d:1,5	01-	Human stools	USA	2004	9508/04	CDC
Yellowknife	9,12:r:e,n,x		Human	Canada	2004	9523/04	NML
Marsabit	52:l,w:1,5	01-	Camel	Kenya	2004	9527/04	BfR
Dingiri	17:z:1,6		Human blood	Gambia	2004	9529/04	SSI
Myrria	13,23:i:1,7		Human stools	Nigeria	2004	9544/05	NIPH
Eaubonne	18:g,s,t:-		Human stools	France	2004	9552/05	IP
Namur	39:z <sub>4</sub> ,z <sub>23</sub> :-	01-	Human stools	Belgium	2005	9585/05	IP/ISP
Lonestar	41:c:-	01-	Human stools	USA	2005	9592/05	CDC
Winslow	13,22:z:1,5	Gal+	Wild pig	USA	2005	9593/05	CDC
Salinas	40:a:1,7		Human stools	USA	2005	9596/05	CDC
Picpus	13,23:z <sub>35</sub> :1,6		Human stools	France	2005	9597/05	IP
Ivrysurseine	13,23:z:z <sub>6</sub>		Human stools	France	2005	9598/05	IP
Chennai	4,12:d:z <sub>35</sub> :-		Prawns	New Zealand	2005	9627/06	ESR
Sandaga	3,10:z <sub>38</sub> :1,2		Human stools	Senegal	2006	9647/06	IP/IPD
Umbadah	1,3,19:d:1,2		Bovine	Sudan	2006	9663/06	LFZ
Heistopdenberg	8,20:b:l,w		Human	Belgium	2006	9665/06	IP/ISP
Etobicoke <sup>a</sup>	28:d:z <sub>6</sub>	01-	Human	Canada	2006	9677/07	NML
Penzing <sup>a</sup>	35:k:e,n,z <sub>15</sub>	01-	Human	Austria	2005	9697/07	IMED
Portedeslilas <sup>a</sup>	1,42:l,v:1,6,7	Dul-	Human blood	France	2007	9700/07	IP
Neuland <sup>a</sup>	16:z <sub>35</sub> :1,5		Plant environment	Germany	2007	9713/07	IHU
Boston <sup>a</sup>	13,23:c:e,n,z <sub>15</sub>		Human stools	USA	2007	9716/07	CDC
Leinster <sup>a</sup>	45:b:1,6		Human	Nigeria	2000	9721/07	NUI
Galway <sup>a</sup>	13,23:k:e,n,z <sub>15</sub>		Human	Nigeria	2007	9722/07	NUI
Ulm <sup>a</sup>	1,6,14,25:z <sub>10</sub> :z <sub>6</sub>		Sesame seed	Germany	2007	9743/07	IHU

Darfur <sup>a</sup>	43:z <sub>41</sub> :1,2		Human	Tchad	2007	9748/07	RKI
Miromesnil <sup>a</sup>	1,3,19:z <sub>4</sub> ,z <sub>23</sub> :-		Human stools	France	2007	9758/07	IP
Serenli <sup>a</sup>	1,13,23:z:1,5		Human stools	Africa	2006	9759/07	NIPH
<b>subsp. <i>salamae</i></b>							
	48:z <sub>39</sub> :z <sub>81</sub>	Gel-, Sal+	Human stools	USA	2003	9505/04	CDC
	6,7:z <sub>4</sub> ,z <sub>23</sub> :-	01-,ONPG+	Human	Canada	2004	9521/04	NML
	40:m,t:e,n,x	01-	Beef	Namibia	2002	9539/05	NIPH
	40:l,z <sub>28</sub> :e,n,x		Beef	Namibia	2002	9540/05	NIPH
	28:m,t:z <sub>39</sub>		Meat	Namibia	2003	9543/05	NIPH
	40:z <sub>10</sub> :e,n,x	ONPG+	Chameleon	Germany	2005	9583/05	BfR
	17:d :- <sup>a</sup>		Beef	Africa	2006	9669/06	NIPH
	60:z <sub>10</sub> :z <sub>39</sub> <sup>a</sup>	Gel-	Human stools	USA	2007	9714/07	CDC
	6,7:z <sub>38</sub> :e,n,x <sup>a</sup>		Human stools	Mozambique	2007	9733/07	NPHI
	48:z <sub>81</sub> :1,5,7 <sup>a,b</sup>	Gel-	Fish meal	Angola	1961	9744/07	IP/IHU
	9,46:l,w:e,n,x <sup>a</sup>		Beef	Namibia	2006	9760/07	NIPH
<b>subsp. <i>arizonae</i></b>							
	48:z <sub>29</sub> :-		Human stools	USA	2002	9379/03	CDC
	45:z <sub>36</sub> :-		Snake	USA	2003	9464/03	CDC
	21:z <sub>36</sub> :-		Human stools	USA	2005	9595/05	CDC
	50:g,z <sub>51</sub> :-	GGT+	Human stools	USA	2005	9628/06	CDC
	18:z <sub>36</sub> :- <sup>a</sup>		Human blood	USA	2006	9715/07	CDC
<b>subsp. <i>diarizonae</i></b>							
	48:z <sub>4</sub> ,z <sub>24</sub> :-	Muc+, Glu-	Snake	Switzerland	2002	9407/03	UVB
	8:k:z <sub>35</sub>	GGT-, Mal-	Avian	USA	2003	9446/03	CDC
	52:k:e,n,x,z <sub>15</sub>		Water	France	2003	9453/03	IP
	63:(k):z		Snake	USA	2003	9488/04	CDC
	43:g,t:-	Muc+, Glu-	Human stools	Sweden	2004	9504/04	SIIDC
	8:r:z	Glu-, Gel-	Human stools	USA	2003	9507/04	CDC
	50:i:z <sub>53</sub>	Muc+, Tar+	Chameleon	Germany	2005	9604/05	BfR
	65:i:z	Muc+	Reptile	Germany	2006	9648/06	BfR
<b>subsp. <i>houtenae</i></b>							
	18:g,z <sub>51</sub> :-		Human	USA	2006	9654/06	CDC
<b><i>Salmonella bongori</i></b>							
	1,9,12:d:e,n,x <sup>a</sup>		Cattle	Finland		9736/07	NPHI

- 1 <sup>a</sup>Serovar name or antigenic formula not recorded in the current (9th) edition of the White-Kauffmann-Le  
2 Minor scheme.  
3 <sup>b</sup>Corresponds to Kauffmann's strain 1357K, originally described as the reference strain of *S. enterica*  
4 subsp. *enterica* serovar Hisingen (48:a:1,5,7).  
5 <sup>c</sup>The differential phenotypical characters of *Salmonella* species and subspecies are indicated in  
6 reference 3. Only the atypical results are mentioned. Tests used :  $\beta$ -galactosidase, ONPG ;  $\beta$ -  
7 glucuronidase, GLU ; gelatinase, Gel ; galacturonate, Gal ; malonate, Mal ; salicin, Sal ; dulcitol,  
8 Dul ; mucate, Muc ; L(+) tartrate (= *d*-tartrate), Tar ;  $\gamma$ -glutamyltransferase, GGT ; lyse by phage O1,  
9 O1. +, positive reaction ; -, negative reaction.  
10 <sup>d</sup>The National Reference Centres having sent the isolates are indicated in the acknowledgments section.

1 **Table 2.** New variants of previously described *Salmonella* serovars recognized by the WHO Collaborating Centre for Reference and Research on  
 2 *Salmonella*, 2003-2007.

3

IP strain number	Antigenic formula	Other characters <sup>a</sup>	Source	Area of contamination or isolation	Year	Received from <sup>b</sup>	Serovar name	Updated antigenic formula
<b><i>S. enterica</i> subsp. <i>enterica</i></b>								
9429/03	43:l,w:z <sub>44</sub>	01-	Human	Switzerland	2003	UVB	Epalinges	43:l,w:[z <sub>44</sub> ]
9445/03	4,12:g,m,s:1,2	Tar-	Turkey	USA	2003	CDC	Hato	<u>1</u> ,4,[5],12:g,m,s:[1,2]
9450/03	{6,7,14}{54}:g,m,s:-		Calf meat	Germany	2003	IHU	Montevideo	{6,7, <u>14</u> }{54}:g,m,[p],s:[1,2,7]
9467/03	1,4,12:i:e,n,z <sub>15</sub>		Human stools	France	2003	IP	Tsevie	<u>1</u> ,4,12:i:e,n,z <sub>15</sub>
9549/05	43:z <sub>4</sub> ,z <sub>23</sub> :1,2		Human stools	Norway	2004	NIPH	Farmingdale	43:z <sub>4</sub> ,z <sub>23</sub> :[1,2]
9554/05	1,4,12:e,h:e,n,z <sub>15</sub>		Sunflower kernels	Germany	2004	IHU	Sandiego	<u>1</u> ,4,[5],12:e,h:e,n,z <sub>15</sub>
9645/06	1,4,12:r:e,n,z <sub>15</sub>		Cattle	Sudan	2006	LFZ	Drogana	<u>1</u> ,4,12,[27]:r,[i]:e,n,z <sub>15</sub>
9658/06	1,4,12:r:l,w		Human stools	France	2006	IP	Bochum	<u>1</u> ,4,[5],12:r:l,w
9717/07	4,5,12:b:1,5	Muc-	Human stools	USA	2006	CDC	Limete	<u>1</u> ,4,[5],12:b:1,5 <sup>c</sup>
9740/07	42:l,v:1,6,7	Dul-	Human stools	Finland	2007	NPHI	Portedeslilas	<u>1</u> ,42:l,v:1,6,7 <sup>c</sup>
9742/07	1,13,23:d:l		Human stools	France	2007	IP	Putten	<u>1</u> ,13,23:d:l,w <sup>c</sup>
9752/07	1,4,12,27:l,v:1,5 <sup>a</sup>		Human stools	France	2007	IP	Azteca	<u>1</u> ,4,[5],12,[27]:l,v:1,5 <sup>c</sup>
<b><i>S. enterica</i> subsp. <i>salamae</i></b>								
9383/03	4,5,12:b:-		Turtle faeces	Germany	2003	BfR		1,4,[5],12,[27]:b:[e,n,x]
<b><i>S. enterica</i> subsp. <i>diarizonae</i></b>								
9469/03	1,40:l,v:z <sub>53</sub>		Human	Israel	2003	GCL		<u>1</u> ,40:l,v:z <sub>53</sub>
<b><i>S. enterica</i> subsp. <i>indica</i></b>								
9437/03	6,14:a:e,n,x	01-	Environment	Switzerland	2003	UVB		[1],6,14,[25]:a:e,n,x

4

5 <sup>a</sup>The differential phenotypical characters of *Salmonella* species and subspecies are indicated in reference 3. Only the atypical results are mentioned. Tests  
 6 used : dulcitol, Dul ; mucate, Muc ; L(+) tartrate (= *d*-tartrate), Tar; lyse by phage O1, O1. +, positive reaction ; -, negative reaction.

7 <sup>b</sup>The National Reference Centres having sent the isolates are indicated in the acknowledgments section.

8 <sup>c</sup>Antigenic formula not recorded or not updated in the current (9th) edition of the White-Kauffmann-Le Minor scheme.

1 **Table 3.** Present number of serovars in each species and subspecies of *Salmonella*.  
 2  
 3

---

4	<i>S. enterica</i>	
5	subsp. <i>enterica</i>	1547
6	subsp. <i>salamae</i>	513
7	subsp. <i>arizonae</i>	100
8	subsp. <i>diarizonae</i>	341
9	subsp. <i>houtenae</i>	73
10	subsp. <i>indica</i>	13
11		
12	<i>S. bongori</i>	23
13		
14	Total	2 610

15

16

17