Recognition of nomenclatural standing of *Salmonella typhi* (Approved Lists 1980), *Salmonella enteritidis* (Approved Lists 1980) and *Salmonella typhimurium* (Approved Lists 1980), and conservation of the specific epithets *enteritidis* and *typhimurium*. Request for an Opinion

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In 1994, the Judicial Commission of the ICSB announced that Le Minor and Popoff's Request for an Opinion in 1987 to designate *Salmonella enterica* sp. nov., nom. rev. as the type and only species of the genus *Salmonella* was denied. Thus, the current species of the genus *Salmonella* are *Salmonella typhimurium*, *Salmonella enteritidis*, *Salmonella typhi*, *Salmonella choleraesuis* (including six subspecies) and *Salmonella bongori*, with the type species, *S. choleraesuis* (Smith 1894) Weldin 1927 (Approved Lists 1980). Because the decision of the Judicial Commission about the request by Le Minor in 1987 was suspended for 7 years, the non-validated name '*S. enterica*' has been used among microbiologists and has caused confusion in the nomenclature of *Salmonella*. In order to overcome such confusion, and because of their importance as human pathogens, we herein propose to recognize the nomenclatural status of *S. typhi*, *S. enteritidis* and *S. typhimurium* as species and request to issue an Opinion to conserve the specific epithets *enteritidis* and *typhimurium* in the species names *Salmonella enteritidis* and *Salmonella typhimurium*.

Keywords: *Salmonella typhi*, *Salmonella enteritidis*, *Salmonella typhimurium*, conserved name, taxonomy

The members of the genus *Salmonella* were divided into more than 2300 serovars and most of them were proved to genetically belong to a single species (Christensen *et al.*, 1998; Crosa *et al.*, 1973; Reeves *et al.*, 1989a; Stoleru *et al.*, 1976). Historically, however, classification of the genus *Salmonella* was exposed to extensive arguments by many microbiologists. In the 1st edition of *Bergey's Manual of Determinative Bacteriology* in 1923 (Bergey *et al.*, 1923), 17 species in the genus *Salmonella* were described and each species was biochemically differentiated. Until the first issue of the *International Bulletin of Bacteriological Nomenclature and Taxonomy* in 1951, several different classification systems based on biochemical traits and antigenic structure have been proposed (Borman *et al.*, 1944; Kauffmann, 1952). In 1948, Kauffmann described 150 'serotypes' in the 6th edition of *Bergey's Manual*

(Kauffmann, 1948), however, in 1952, he described only three species, which could be differentiated by biochemical tests (Kauffmann & Edwards, 1952). In 1980, the Approved Lists of Bacterial Names (Skerman *et al.*, 1980) cited five species in the genus *Salmonella*: *S. typhi*, *S. enteritidis*, *S. choleraesuis*, *S. arizonae* and *S. typhimurium*, among more than 2000 serovars in the genus *Salmonella*.

In 1982, based on the results of numerical analysis and DNA–DNA hybridization among 88 *Salmonella* reference strains belonging to be subgenera I–IV by Kauffman (Le Minor *et al.*, 1982a). Le Minor *et al.* (Le Minor *et al.*, 1982b) proposed to combine four *Salmonella* subgenus strains into a single species, namely *Salmonella choleraesuis*, and described six subspecies; *S. choleraesuis* subsp. *choleraesuis*, *S.*

choleraesuis subsp. *salamae*, *S. choleraesuis* subsp. *arizonae*, *S. choleraesuis* subsp. *diarizonae*, *S. choleraesuis* subsp. *houtenae*, *S. choleraesuis* subsp. *bongori*. This proposal was made outside the *International Journal of Systematic Bacteriology* (IJSB) and the six subspecies appeared later in the Validation List no. 18 (Le Minor *et al.*, 1985).

Through this proposal, Le Minor *et al.* intended to place all *Salmonella* serovars in the *Salmonella choleraesuis* subsp. *choleraesuis* in his original report which appeared in the journal of the Pasteur Institute (Le Minor *et al.*, 1986; Le Minor & Popoff, 1987). However, an official proposal to place *S. typhi*, *S. typhimurium* and *S. enteritidis* as subjective synonyms of *Salmonella choleraesuis* subsp. *choleraesuis*, did not appear in a Validation List in IJSB. So, *S. typhi*, *S. typhimurium* and *S. enteritidis* remained as validly named species. Only the six subspecies that he proposed were later cited in Validation List no. 18 (Le Minor *et al.*, 1985).

The seventh subspecies, *S. choleraesuis* subsp. *indica*, was proposed by Le Minor *et al.* (Le Minor *et al.*, 1986) and validly named in List no. 23 (Le Minor *et al.*, 1987). Thus, at this stage, *S. choleraesuis* contained seven subspecies.

After the proposal of Le Minor *et al.* in 1982, Le Minor and Popoff requested an Opinion to designate *Salmonella enterica* sp. nov., nom. rev. as the type species of the genus *Salmonella* in 1987 (Le Minor & Popoff, 1987), i.e. they proposed *S. enterica* as a single species in the genus *Salmonella*. *S. typhi*, *S. typhimurium* and *S. enteritidis* were included in the *S. enterica*. *Salmonella enterica* originally was used by Edwards & Ewing (1963). Le Minor *et al.* designated strain LT2 as the type strain of *S. enterica*. This strain was the reference strain for *S. typhimurium*. After the submission of Le Minor and Popoff's Request for an Opinion, the Judicial Commission took 7 years to act on it and finally did not accept Le Minor and Popoff's proposal (Wayne, 1994). However, Le Minor and Popoff's proposal was widely distributed among microbiologists.

In 1989, *S. choleraesuis* subsp. *bongori* was placed as a distinct species, *S. bongori* (Le Minor *et al.* 1985) Reeves *et al.* 1989 (Reeves *et al.*, 1989a, b). Thus, currently, five species and six subspecies of *S. choleraesuis* have taxonomic positions as in Table 1.

From the historical background, nomenclature of the members of the genus *Salmonella* has been confused in the scientific community. The species name of *Salmonella typhi* is still valid nomenclaturally although this species is genetically identical to *S. choleraesuis* subsp. *choleraesuis* because of their high DNA–DNA similarity value (Crosa *et al.*, 1973; Stoleru *et al.*, 1976). However, the name of this organism was well known and used from early in the last century because this organism causes severe epidemic disease, typhoid fever. The organism is also listed as a Level 3 pathogen

Table 1. Validly named species and subspecies in the genus *Salmonella*

Validly named taxa	Type strain
<i>Salmonella choleraesuis</i>	ATCC 13312
<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i>	ATCC 13312
<i>Salmonella choleraesuis</i> subsp. <i>salamae</i>	CIP 8229
<i>Salmonella choleraesuis</i> subsp. <i>arizonae</i>	ATCC 13314
<i>Salmonella choleraesuis</i> subsp. <i>diarizonae</i>	CIP 8231
<i>Salmonella choleraesuis</i> subsp. <i>houtenae</i>	CIP 8232
<i>Salmonella choleraesuis</i> subsp. <i>indica</i>	CIP 102501
<i>Salmonella enteritidis</i>	ATCC 13076
<i>Salmonella typhimurium</i>	ATCC 13311
<i>Salmonella typhi</i>	ATCC 19430
<i>Salmonella bongori</i>	CIP 8233

in the bacterial hazard group of the WHO and many countries. Further, the specific epithet *typhi* in combination with the genus name *Salmonella* is conserved by Opinion 18 in 1963 (Editorial Board, 1963). To clarify the position of the name *S. typhi*, we propose that the Judicial Commission act to recognize the species *S. typhi* as a legitimate name and confirm the name as *nomen conservandum* according to Rule 56b.

Concerning rejection of names, ICSB added a new item, (5), to Rule 56a: 'a perilous name (*nomen periculosum*), i.e., a name whose application is likely to lead to accidents endangering health or life or both or of serious economic consequences' (Lapage *et al.*, 1992). The attempt to change the name of *S. typhi* to *S. choleraesuis* subsp. *choleraesuis* serovar *typhi* should be rejected according to Rule 56a.

Though strains of *S. typhimurium* and *S. enteritidis* are also genetically identical to *S. choleraesuis* subsp. *choleraesuis* (Christensen *et al.*, 1998; Crosa *et al.*, 1973; Stoleru *et al.*, 1976), these two species name appeared in the Approved Lists and retained their nomenclatural standing. In contrast to this, *S. choleraesuis* subsp. *choleraesuis* serovar *typhimurium*, *S. choleraesuis* subsp. *choleraesuis* serovar *enteritidis* are to be rejected as *nomina periculosa* since the two species are now most important human and animal pathogens. They cause outbreaks of food poisoning and fatal systemic infection among children. Their names are widely recognized and appeared in the Approved Lists of Bacterial Names (Skerman *et al.*, 1980, 1989). We propose to the Judicial Commission to act to re-recognize *S. typhimurium* and *S. enteritidis* as legitimate names and Request an Opinion to protect their specific epithets as *nomina conservanda*.

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