Recommendations of the Subcommittee on the taxonomy of *Campylobacter* and related bacteria

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The ICSB Subcommittee on the taxonomy of *Campylobacter* and related bacteria has discussed several contemporaneous issues and makes the following recommendations. (i) The reported synonymy between *Campylobacter coli* and *Campylobacter hyoilei* was based on valid taxonomic arguments. The subcommittee therefore discourages the use of the name *C. hyoilei*. (ii) The revised infrasubspecific nomenclature of *Campylobacter sputorum* is endorsed. *C. sputorum* is subdivided into *C. sputorum* biovar *sputorum* (characterized by the absence of catalase and urease activity); *C. sputorum* biovar *faecalis* (characterized by catalase but not urease activity); and *C. sputorum* biovar *paraureolyticus* (characterized by urease, but not catalase activity). (iii) The subcommittee points out that '*Flexispira rappini*' is a taxon that is circumscribed by means of morphological criteria. It encompasses multiple *Helicobacter* species, including *Helicobacter bilis* and *Helicobacter trogontum*. (iv) Finally, the subcommittee wishes to point out that the etymology of several specific or subspecific epithets of *Campylobacter* taxa has been corrected and that the spelling of the epithet 'fecalis' was corrected to 'faecalis'.

Keywords: *Campylobacter*, ICSB subcommittee recommendations, nomenclature

One of the tasks of taxonomic subcommittees of the International Committee on Systematic Bacteriology (ICSB), now known as the International Committee on Systematics of Prokaryotes (ICSP), is to make recommendations regarding taxonomic procedures, changes in nomenclature, recognition of types of various taxa, or classification. In the past years, statements related to several of these issues have appeared in the minutes of the meetings of the subcommittee. However, the statutes of the ICSB/ICSP specify that such statements should also be submitted as separate papers (Article 9 regarding organization and functions of the subcommittees on taxonomy). The present manuscript summarizes the conclusions concerning four issues that were discussed during recent meetings of the ICSB Subcommittee on the taxonomy of *Campylobacter* and related bacteria.

Taxonomic status of *Campylobacter hyoilei*

The taxonomic position of 11 isolates from lesions of proliferative enteritis in pigs was studied by Alderton *et al.* (1995). They considered the strains to represent a species closely related to *Campylobacter coli* and *Campylobacter jejuni* and proposed the name *Campylobacter hyoilei* (Alderton *et al.*, 1995). The taxonomic position of *C. hyoilei* was reevaluated by Vandamme *et al.* (1997) by using a range of phenotypic and genotypic methods and, crucially, a classical quantitative DNA–DNA hybridization method. These data showed *C. hyoilei* to be indistinguishable from *C. coli*. Vandamme *et al.* (1997) proposed that the two species be regarded as synonymous, with *C. coli* taking nomenclatural precedence. The subcommittee members agreed to discourage the use of the name *C. hyoilei* in favour of *C. coli*. It was nonetheless noted that strains originally described as *C. hyoilei* may represent a variant of *C. coli* that is highly adapted for the porcine enteric tract, with pathologic consequences for the animal. Therefore, the epithet 'hyoilei' could in principle be revived as an infrasubspecific designation,

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if reliable pathogenic, phenotypic or genetic traits can be determined for identification.

Revised infrasubspecific nomenclature of *Campylobacter sputorum*

Campylobacter strains isolated from the human oral cavity and the genital tract of bulls were initially believed to be related at the subspecies level on the basis of their extensive biochemical similarities, and were named *C. sputorum* subsp. *sputorum* and *C. sputorum* subsp. *bubulus*, respectively (Véron & Chatelain, 1973). Subsequent DNA hybridization studies (Roop *et al.*, 1985) revealed a high level of DNA–DNA relatedness between these taxa, and also towards '*Campylobacter fecalis*' (from sheep faeces). Limited biochemical variation between these taxa had been noted and thus Roop *et al.* (1985) proposed that the aforementioned taxa be referred to as source-specific biovars of *C. sputorum* (biovar *sputorum*, biovar *bubulus*, and biovar *fecalis*, respectively). The legitimacy of biovar *bubulus* as a distinct taxon was questioned when the tests used to distinguish biovar *sputorum* from biovar *bubulus* were found to be poorly reproducible, even when using highly standardized conditions for testing (On *et al.*, 1994, 1998). The absolute validity of the source-specific biovar concept was also challenged since some *C. sputorum* strains from sheep and pigs could not be distinguished from those of bovine and human origin (On *et al.*, 1994, 1998). The recent identification of urease-positive isolates of *C. sputorum* from cattle faeces resulted in the proposal of a new biovar structure, defined by reactions in two simple and reproducible tests (catalase and urease). *C. sputorum* biovar *sputorum* strains do not produce catalase, nor urease; *C. sputorum* biovar *faecalis* strains produce catalase but not urease; and *C. sputorum* biovar *paraureolyticus* strains produce urease, but not catalase. None of these biovars is host specific. The subcommittee agreed to endorse the revised biovar nomenclature of *C. sputorum*.

Taxonomic status of '*Flexispira rappini*'

'*Flexispira rappini*' is a provisional name given to Gram-negative, microaerobic, motile, spindle-shaped bacteria with spiral periplasmic fibres and bipolar tufts of sheathed flagella. Strains with this distinctive morphology have been isolated from various sources including aborted lambs, canine faeces and gastric mucosa, intestinal mucosa of laboratory mice, and pig intestines (Bryner, 1987; Archer *et al.*, 1988; Schauer *et al.*, 1993; Jalava *et al.*, 1998), and from stool and blood samples of children and adults (Tee *et al.*, 1998; Sorlin *et al.*, 1999). Strains described as '*Flexispira rappini*' belong to the genus *Helicobacter* by phylogenetic analysis and share their unusual morphological features with several named *Helicobacter* species, including *Helicobacter bilis* (Fox *et al.*, 1995) and *Helicobacter trogonum* (Mendes *et al.*, 1996). Considerable diversity in the 16S rRNA gene of 35

strains that exhibit these distinctive morphological characteristics has been observed (Dewhirst *et al.*, 2000). A polyphasic investigation of the relationships between all these strains is required to clarify the taxonomic position and status of this complex group within the genus *Helicobacter*. However, at present the name '*Flexispira rappini*' refers to a characteristic morphotype shared by several distinct taxa, and not to a distinct well-defined species. We draw this fact to the attention of the scientific community that deals with these organisms.

Matters regarding the etymology of specific or subspecific epithets of *Campylobacter*

Members of the subcommittee had recently noted that several specific or subspecific epithets of *Campylobacter* taxa were erroneously formed. This required correction of the spelling of the epithet or, alternatively, correction of the etymology. The subcommittee members reached a consensus to correct the etymology of the specific epithets '*fetus*' (of *Campylobacter fetus*), '*jejuni*' (of *Campylobacter jejuni*), and '*mucosalis*' (of *Campylobacter mucosalis*), and the subspecific epithet '*venerealis*' (of *C. fetus* subsp. *venerealis*). The spelling of the biovar name '*fecalis*' (of *Campylobacter sputorum* biovar *fecalis*) was corrected to '*faecalis*'.

The correct etymologies for these five epithets are:

- fe'tus. L. masc. n. *fetus* fetus, fruit; L. gen. masc. n. *fetus* of a fetus;
- ve.ne.re.a'lis. M.L. (arbitrary) adj. *venerealis* pertaining to venereal disease;
- mu.co.sa'lis. M.L. adj. *mucosalis* pertaining to the (*tunica*) *mucosa* mucous membrane;
- je.ju'ni. M.L. gen. neut. n. *jejuni* of the jejunum;
- fae.cal'is. L. n. *faex* dregs; L. suffix *-alis*, adjective-forming suffix: M.L. masc. adj. *faecalis* pertaining to faeces.

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