NOTES

Listeria ivanovii sp. nov.

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Biochemical, genomic, and serological data indicate that strains currently referred to as *Listeria monocytogenes* serovar 5 are sufficiently distinct from other species of the genus *Listeria* to merit separate species status. It is proposed that these strains be designated *Listeria ivanovii* sp. nov. The type strain of *L. ivanovii* is strain SLCC 2379 (= ATCC 19119).

The unsatisfactory taxonomic status of strains designated *Listeria monocytogenes* serovar 5 (5) has been noted for some time (4). Ivanov (4) considered that strains so designated were sufficiently distinct from other strains of *L. monocytogenes* to be recognized as a separate species, for which he suggested the name "*Listeria bulgarica*." However, no type strain was designated, and this name lost standing in bacterial nomenclature when it was omitted from the Approved Lists of Bacterial Names (15). Later, Seeliger et al. (13) recommended that *L. monocytogenes* serovar 5 strains be recognized either as a subspecies, "*Listeria monocytogenes* subsp. *perhaemolytica*," or as a distinct species, which could be named either "*Listeria perhaemolytica*" or "*Listeria ivanovii*." Although this recommendation reflected the opinion of these authors that serovar 5 strains represented a taxon distinct from *L. monocytogenes*, it did not constitute a proposal for recognition of a new species. Therefore, the taxonomic status of *L. monocytogenes* serovar 5 remained unresolved.

Recent deoxyribonucleic acid relatedness studies (8) with 66 strains of *L. monocytogenes* have shown that this species, as defined in *Bergey's Manual of Determinative Bacteriology*, 8th ed. (14), contains five genomic groups. The deoxyribonucleic acid relatedness values (as determined by the S1 nuclease-trichloroacetic acid method) of 18 to 58% among the five groups with differences between the thermal denaturation midpoints of the homoduplexes and the thermal denaturation midpoints of the heteroduplexes of more than 7.1°C provided strong evidence that each of the genomic groups represents a distinct species (1, 9). Genomic group 1 contained the type strain (strain ATCC 15313) of *L. monocytogenes* and thus corresponded to *L. monocytogenes* sensu stricto (8). Genomic groups 3, 4, and 5 corresponded to the recently named species *Listeria innocua* (11), *Listeria welshimeri*, and *Listeria seeligeri* (9), respectively.

Genomic group 2 contained all nine strains of *L. monocytogenes* serovar 5 examined, including strain SLCC 2379^T (T = type strain; Special *Listeria* Culture Collection of the Institute of Hygiene and Microbiology of the University of Würzburg, Würzburg, Federal Republic of Germany; = ATCC 19119^T). The levels of deoxyribonucleic acid relatedness (S1 nuclease-trichloroacetic acid method) of the other eight strains in genomic group 2 to strain SLCC 2379^T were

99 ± 5% (differences between the thermal denaturation midpoints of the homoduplexes and the thermal denaturation midpoints of the heteroduplexes less than 1.2°C). Strain SLCC 2379^T and another strain of genomic group 2, strain SLCC 3769, were 39 and 22% related, respectively, to strain SLCC 53 (= ATCC 15313), the type strain of the type species, *L. monocytogenes*. Therefore, as noted by Rocourt et al. (8, 9), the strains of *L. monocytogenes* serovar 5 constitute a distinct genomic species.

The results of recent biochemical and serological studies (10, 13) on strains of *L. monocytogenes* serovar 5 and strains of *L. innocua*, *L. monocytogenes* sensu stricto, *L. seeligeri*, and *L. welshimeri*, together with the data from earlier studies on strains of *L. monocytogenes* serovar 5 (3-5), support separate species status for these strains. In addition to their distinctive antigenic composition and their pronounced hemolytic activity on blood agar, *L. monocytogenes* serovar 5 strains exhibit a positive CAMP test with *Rhodococcus equi*.

L. monocytogenes serovar 5 strains are experimentally pathogenic for mice (7, 13), but the 50% lethal dose of these strains is 10 times higher than that of *L. monocytogenes* sensu stricto, *L. innocua*, *L. seeligeri*, and *L. welshimeri* are nonpathogenic for mice (7). *L. monocytogenes* serovar 5 strains have been reported as the causative agent of abortion, mainly in sheep (2-4, 6). Infection of humans is very rare (13). Therefore, it is possible that the basis of the pathogenicity of *L. monocytogenes* serovar 5 strains is different from that of *L. monocytogenes* sensu stricto, which is mainly responsible for meningo-encephalitis, septicemia, and neonatal sepsis in humans and animals.

The purpose of this paper is to propose the name *Listeria ivanovii* sp. nov. for genomic species 2 of Rocourt et al. (8), which contains the bacteria currently referred to as *L. monocytogenes* serovar 5. The physiological, biochemical, pathogenic, and genetic characteristics of the designated type strain, strain SLCC 2379^T, and other representative strains have been published previously by us and other workers (3-5, 7, 9, 10, 12, 13).

Description of *Listeria ivanovii* sp. nov. *Listeria ivanovii* sp. nov. (i.van.ov'i.i. M.L. gen. noun *ivanovii* of Ivanov, honoring Ivan Ivanov, a Bulgarian microbiologist) cells are small, nonsporing, gram-positive rods which are motile at 28°C. Colonies on tryptose agar (Difco Laboratories) are very small (0.5 to 1 mm in diameter after 1 or 2 days of incubation at 37°C), regular, and smooth and appear blueish green when

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they are viewed by obliquely transmitted light. Colonies on sheep or horse blood (5%, vol/vol) agar are strongly β -hemolytic.

A positive CAMP test is exhibited with *R. equi* (strain CIP 5869) but not with *Staphylococcus aureus*. Growth occurs at 4°C within 5 days. Facultatively anaerobic. Catalase is produced. The oxidase test is negative. Acid but no gas is produced from glucose and D-xylose. No acid is produced from D-mannitol, L-rhamnose, or α -methyl-D-mannoside. Voges-Proskauer and methyl red tests are positive. Esculin is hydrolyzed in 1 day. Urea is not hydrolyzed. Gelatin is not hydrolyzed. Neither indole nor H₂S is produced. Nitrates are not reduced to nitrite. Strains possess a distinctive antigenic composition referred to as serological group 5 (12). The 50% lethal dose for holoxenic pathogen-free mice is between 1×10^5 and 3×10^6 colony-forming units per ml. Pathogenic for animals, especially for pregnant sheep; the species has also been isolated from healthy animals and human carriers and from the environment (13). The guanine-plus-cytosine content of the deoxyribonucleic acid is 38 mol% (determined by melting temperature [9]).

The type strain is SLCC 2379 (= ATCC 19119). This strain was isolated by I. Ivanov from sheep.

Description of the type strain. The description of the type strain is the same as that of the species. This strain is one of the set of reference strains used for serological analysis of *Listeria* strains (12).

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