The status of the species *Moorella thermoautotrophica* Wiegel et al. 1981. Request for an Opinion

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Based on the results of DNA–DNA hybridization and 16S rRNA gene sequence analyses, it was ascertained that the type strain of *Moorella thermoautotrophica* does not exist in any established culture collection or with the authors who originally described this species. Therefore, this species cannot be included in any further scientific studies. It is proposed that the Judicial Commission place the name *Moorella thermoautotrophica* on the list of rejected names if a suitable type strain is not found or a neotype is not proposed within two years following the publication of this Request for an Opinion.

Abbreviation: OTU, Operational Taxonomic Unit.

The GenBank/EMBL/DBJ accession numbers for the 16S rRNA gene sequences of Operational Taxonomic Unit (OTU) groups 1, 2, 3 and 4 are LC133084-LC133087, respectively.

*Moorella thermoautotrophica* JW701/3T was originally isolated from a hot spring located in Yellowstone National Park by Wiegel et al. (1981) and is phylogenetically related to *Moorella thermoautotica*. The main difference between these two species is the ability to degrade arabinose and methanol, and growth activity at 70 °C (Wiegel et al., 1981).

The type strain of *M. thermoautotrophica*, JW701/3T, was deposited in seven culture collections as DSM 1974T, ATCC 33924T, NRRL B-23499T, CIP 108447T, BCRC 14412T, EBCC 1489T and KCTC 3246T and KCTC 5016T. The GenBank/EMBL/DBJ accession number for the 16S rRNA gene sequence of strain DSM 1974T (=JW701/3T) is L09168 (Rainey et al., 1993). In the original description of *M. thermoautotrophica* by Wiegel et al. (1981), the DNA–DNA hybridization value between *M. thermoautotica* DSM 521T and *M. thermoautotrophica* JW701/3T was reported to be 50%. In addition, the 16S rRNA gene sequence of the type strain (GenBank accession no. L09168) showed 99.2% sequence similarity to that of *M. thermoautotica* DSM 521T.

In the present study, we investigated the 16S rRNA gene sequence similarities of *M. thermoautotrophica* DSM 1974T and ATCC 33924T, and showed that the 16S rRNA gene sequences of strains DSM 1974T and ATCC 33924T are not identical to the sequence with GenBank accession number L09168. In addition, the DNA–DNA hybridization value between strain DSM 1974T and *M. thermoautotica* DSM 521T was determined to be 85%. The results were distinctly different from that shown previously (Wiegel et al., 1981). Therefore, we performed single colony isolation from dried cells of the type strains, and isolated single colonies of both strains by the standard dilution and modified Hungate roll-tube methods (Hungate, 1969), and determined the 16S rRNA gene profiles of 31 isolates. However, on comparison of the 16S rRNA gene sequences obtained from strains DSM 1974T and ATCC 33924T, it was revealed that none of the sequences were similar to *M. thermoautotrophica* DSM 1974T (L09168), and a total of four different sequences were detected. These four sequence groups were named Operational Taxonomic Unit (OTU)-1, 2, 3 and 4. Three of the four OTUs were similar to known sequences from strains within *M. thermoautotica* and *M. thermoautotrophica*. Specifically, the sequence similarity coefficient was 100% for OTU-1 (GenBank accession no. LC133084) and *Moorella* sp. strain AIP384.98 (AY766036); that for OTU-2 (LC133085) and *M. thermoautotica* DSM 521T (AY656675) was 99.7% and that for OTU-3 (LC133086) and *Moorella* sp. strain HUC22-1 (AB127110) was 100%. Moreover, the closest relative of OTU-4 (LC133087) was *Moorella humiferrea* strain 64_FGQ T (GQ872425; 99.2%). Phylogenetic relationships of these sequences is illustrated in Fig. 1. Four different 16S rRNA gene sequences were detected from strains isolated from cultures of two type strains of *M. thermoautotrophica* and did not match with known sequences (L09168).

Taken together, these findings indicate that the deposited cultures of strains DSM 1974T and ATCC 33924T have been contaminated.
The history of strain DSM 1974\textsuperscript{T} was further investigated using the StrainInfo database (http://www.straininfo.net/strains/157646) (Dawyndt et al., 2005), and incomplete information for strains NRRL B-23499\textsuperscript{T}, CIP 108447\textsuperscript{T}, BCRC14412\textsuperscript{T}, KCTC 3246\textsuperscript{T} and KCTC 5016\textsuperscript{T} was complemented by enquiries to the respective culture collections. The chronological sequence of exchanges and deposits of these cultures is illustrated in Fig. 2. Only DSM 1974\textsuperscript{T} and ATCC 33924\textsuperscript{T}, which is derived from DSM 1974\textsuperscript{T}, are currently available as type strains. Clone analysis revealed that both cultures consisted of four different OTUs that are not similar to \textit{M. thermoautotrophica} DSM 1974\textsuperscript{T} (L09168). Because all type strains of \textit{M. thermoautotrophica} were derived from DSM 1974\textsuperscript{T} and ATCC 33924\textsuperscript{T}, as shown in Fig. 2, all deposited cultures of type strains of \textit{M. thermoautotrophica} worldwide appear to be contaminated.

In conclusion, 16S rRNA gene sequence analysis detected different sequences from the DSM 1974\textsuperscript{T} and ATCC 33924\textsuperscript{T} type strains of \textit{M. thermoautotrophica}. However, because identical 16S rRNA gene sequences between DSM 1974\textsuperscript{T} and ATCC 33924\textsuperscript{T} were also detected, and because all deposited cultures of type strains of \textit{M. thermoautotrophica} were derived from ATCC 33924\textsuperscript{T} and DSM 1974\textsuperscript{T}, these results indicate that the type strain of \textit{M. thermoautotrophica} does not exist in any culture collection worldwide.
According to Rule 18c of the International Code of Nomenclature of Bacteria (Parker et al., 2015), if a suitable replacement type strain or a neotype cannot be found or proposed, respectively, within two years of the publication of this Request for an Opinion, it is proposed that the Judicial Commission places the name *M. thermoautotrophica* on the list of rejected names.

**References**


