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ORIGINAL PAPER

Microbial taxonomy in the era of OMICS: application of DNA sequences, computational tools and techniques

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Abstract The current prokaryotic taxonomy classifies phenotypically and genotypically diverse microorganisms using a polyphasic approach. With advances in the next-generation sequencing technologies and computational tools for analysis of genomes, the traditional polyphasic method is complemented with genomic data to delineate and classify bacterial genera and species as an alternative to cumbersome and error-prone laboratory tests. This review discusses the applications of sequence-based tools and techniques for bacterial classification and provides a scheme for more robust and reproducible bacterial classification based on genomic data. The present review highlights promising tools and techniques such as ortho-Average Nucleotide Identity, Genome to Genome Distance Calculator and Multi Locus Sequence Analysis, which can be validly employed for characterizing novel microorganisms and assessing phylogenetic relationships. In addition, the review discusses the possibility of employing metagenomic data to assess the phylogenetic associations of uncultured microorganisms. Through this article, we present a review of genomic approaches that can be included in the scheme of taxonomy of bacteria and archaea based on computational and in silico advances to boost the credibility of taxonomic classification in this genomic era.

Keywords Bacterial taxonomy · DNA–DNA hybridization · 16S rRNA gene · Genomics · Metagenomics

Introduction

Prokaryotic taxonomy is pragmatic and gradually evolving as more and more organisms are being discovered with advancement in technological innovations. In the late nineteenth century, bacterial strains were delineated by using only phenotypic properties (Cohn 1872), which were soon found insufficient to classify diverse microorganisms that were subsequently isolated. Hence, physiological, chemotaxonomic and biochemical properties of bacteria were included in the bacterial classification system (Orla-

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