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CUPRIAVIDUS – A BACTERIAL GENUS THAT IS BOTH GOOD AND BAD

L. O. Björn

Unit of Molecular Biosciences, Department of Biology, Lund University, Sölvegatan 35, 22362 Lund, Sweden; E-mail: Lars_Olof.Bjorn@biol.lu.se

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Cupriavidus is a bacterial genus related to *Burkholderia*, with members that can be negative or positive for us. Some species can give people serious, and even deadly diseases. Among the species positive for us is one that can be used for replacing plastic production from fossil oil by a more sustainable method.

Key words: *Cupriavidus*, disease, infection, petroleum replacement, *Ralstonia*

Let us start with an overview of *ca* 10 species in this genus, of which Moriuchi *et al.* (2019) have published two genealogies. They are rather similar, and it is sufficient here to show the one based on 16S rRNA-(ribosomal) genes (Fig. 1). The phylogeny of the genus *Cupriavidus* has been published by Andam *et al.* (2007). A simplified and modified version of their tree is presented here (Fig. 2).

Now comes the sad part of the chapter – it will lighten up further on. Some species of *Cupriavidus* can give people serious, and even deadly diseases. Even *C. metallidurans*, better known in more positive contexts (see below), can make people ill (Langevin *et al*. 2011). Other species of *Cupriavidus* are known only as carriers of illness, such as pneumonia caused by *C. gilardii* (Jamwal *et al*. 2023) and sepsis caused by *C. gilardii* (Kweon *et al*. 2020), as well as an infection caused by an unknown species after implantation of a cardiac defibrillator (Christensen *et al*. 2010). A woman who had a device implanted that provided electrical stimulation for treatment of Parkinson's disease was infected by, among other bacteria, *C. pauculus* (Shenai *et al*. 2019) and *C. pauculus* has also caused other human infections (Bianco *et al*. 2018, Tian *et al*. 2022); the latter bacterium was resistant against meropenem and colistin and caused septic shock. A strain of *C. taiwanensis* proved resistant against several antibiotica (Lopez and Ruiz 2024).

Two species of *Cupriavidus* have been treated in many more publications than all other *Cupriavidus* species together: *C. metallidurans* has got its name because of its ability to tolerate high concentrations of heavy metal ions.

Gold complexes and copper ions "cooperate" as toxins because Au(I/III)-complexes block export of Cu(I) from the cytoplasm by the copper-efflux pump CupA. In *C. metallidurans* the resistance against copper and gold is mediated by the periplasmic Cu(I)-oxidase CopA, which acts as an oxygen-consuming Au(I)-oxidase (Bütof *et al.* 2018).

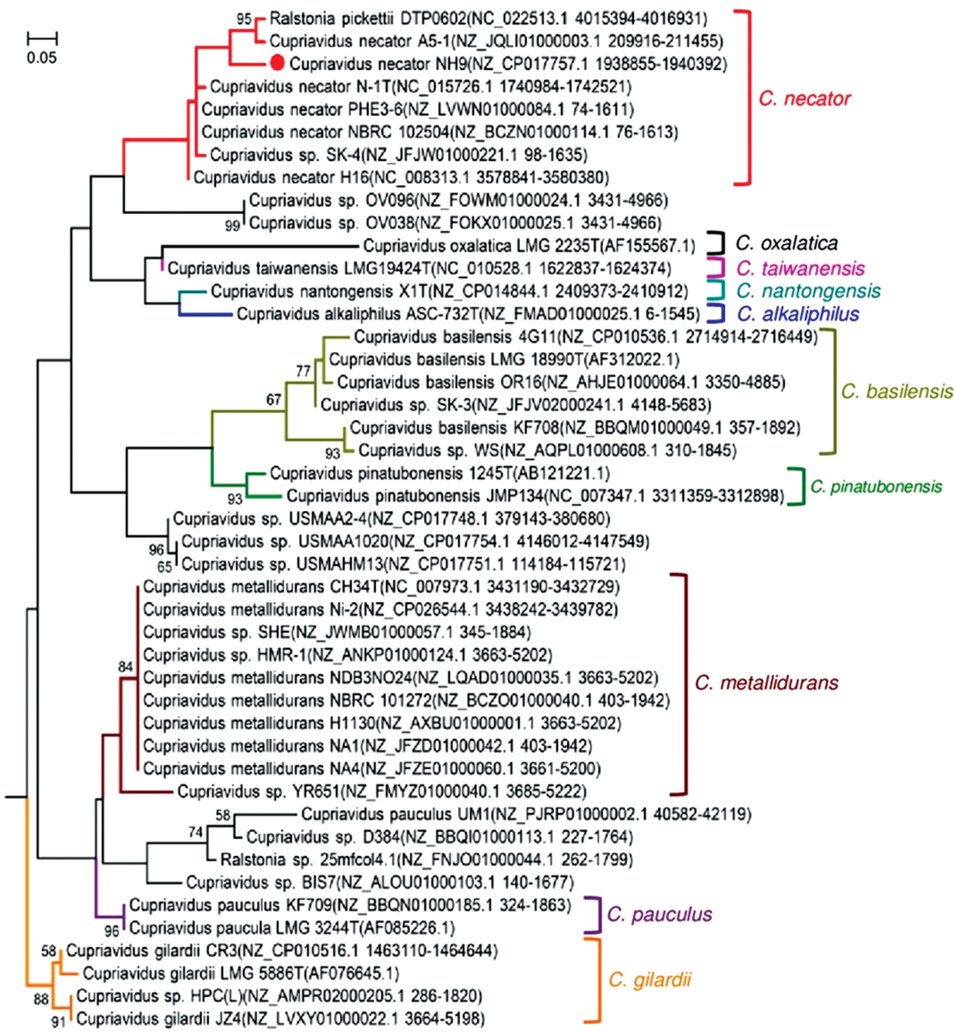

Fig. 1. Overview of the genus *Cupriavidus* based on rRNA-genes according to Moriuchi *et al.* (2019). Republished under the terms of the Creative Commons Attribution License (CC BY). Slightly different versions, also based on 16S rRNA-genes, have been published by Kweon *et al.* (2020) and Kugler *et al.* (2022)

Resistance against uranium is mediated by a periplasmatic protein, $PrsQ_2$ (Mijnendonckx *et al.* 2023).

Let us now concentrate on the hydrogen gas consuming *C. necator*, also known under the name *Ralstonia eutropha*, which in an efficient way uses carbon dioxide as the only source of carbon, hydrogen as electron donor (reductant), and molecular oxygen as electron acceptor (oxidant) (Lambauer *et al.* 2023). Surplus carbon dioxide is stored as poly-(R)-3-hydroxybutyrate, which can be used for production of plastic. A disadvantage is that the bacterium is to be fed with an almost explosive mixture of carbon dioxide, hydrogen and oxygen gases.

The possibility to use a suitable strain of *C. necator* for replacing plastic production from fossil oil by a more sustainable method has also been ex-

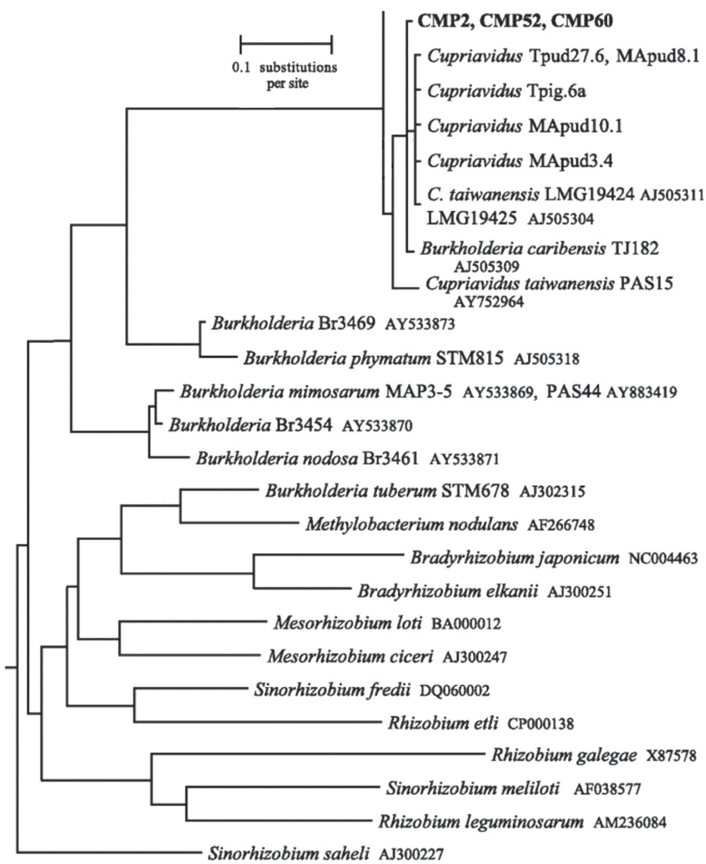

Fig. 2. Phylogeny of *Cupriavidus* and *Burkholderia*. The names do not quite match how the bacteria are related. According to the phylogeny, *Burkholderia caribensis* should be combined in *Cupriavidus*. The tree is a modified and simplified version based on Andam *et al.* (2007)

plored by Morlino *et al.* (2023). This species can also be used for manufacture of other products from carbon dioxide (Pan *et al.* 2021). The relationships of *Cupriavidus* are shown in Figure 2.

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