Deinococcus mumbaiensis Shashidhar and Bandekar 2006 is a later heterotypic synonym of *Deinococcus ficus* Lai *et al.* 2006

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Deinococcus mumbaiensis DSM 17424^T was compared with *Deinococcus ficus* CC-FR2-10^T to clarify the taxonomic relationship between the two species. 16S rRNA gene sequence comparisons demonstrated that these strains share 99.5 % sequence similarity. Investigation of fatty acid patterns and substrate utilization profiles displayed no striking differences between the type strains of the two species. DNA–DNA hybridizations between the two strains showed 75.4 % (76.6 %) relatedness. Therefore, the reclassification of *Deinococcus mumbaiensis* as a later heterotypic synonym of *Deinococcus ficus* is proposed, based upon the estimated phylogenetic position derived from 16S rRNA gene sequence data, fatty acid and biochemical data and DNA–DNA hybridization results.

Deinococcus mumbaiensis was proposed by Shashidhar & Bandekar (2006a) for a radiation-resistant, pleomorphic bacterium isolated from Mumbai, India. The name was validly published in May 2006 (Shashidhar & Bandekar, 2006b). *Deinococcus ficus* was described in April 2006 by Lai *et al.* (2006) for a pale-pink-pigmented bacterium isolated from the rhizosphere of *Ficus religiosa* L.

The two species were described at nearly the same time in different journals. Soon after the publication of the two studies, it became obvious that these species were closely related on the basis of 16S rRNA gene sequence similarity. 16S rRNA gene sequences of *Deinococcus mumbaiensis* CON-1^T (GenBank accession no. DQ003135) and *Deinococcus ficus* CC-FR2-10^T (AY941086) shared a similarity of 99.5 %. A further comparative phenotypic analysis supported this finding. Fatty acid methyl esters were prepared, separated and identified according to the instructions of Microbial Identification System (MIDI; Microbial ID) (Kämpfer & Kroppenstedt, 1996). The fatty acid profiles of the two strains are shown in Table 1. The difference in the content of iso-C_{17:1}ω9c, which might be considered to be significant, is in fact within a range that has also been detected for other fatty acids in strains of *Deinococcus* species (Rainey *et al.*, 2005; Lai *et al.* 2006).

Physiological/biochemical tests were performed with methods described previously (Kämpfer *et al.*, 1991). The two strains shared the following biochemical characteristics. Aesculin, *p*-nitrophenyl (pNP) α-D-glucopyranoside, pNP β-D-glucopyranoside, bis-pNP phosphate, bis-pNP

phenylphosphonate and bis-pNP phosphorylcholine are hydrolysed on the basis of the method described by Kämpfer *et al.* (1991). The following compounds are not hydrolysed: pNP β-D-galactopyranoside, pNP β-D-glucuronide, pNP β-D-xylopyranoside, L-alanine *p*-nitroanilide (pNA), L-proline pNA and γ-L-glutamate pNA. D-Fructose, D-ribose and L-alanine are used as sole sources of carbon. The following compounds were not utilized: *N*-acetylgalactosamine, L-arabinose, L-arbutin, D-galactose, sucrose, D-xylose, D-mannitol, D-sorbitol, citrate, fumarate, glutarate, DL-3-hydroxybutyrate, DL-lactate, L-malate, 2-oxoglutarate, pyruvate, L-proline, L-serine, D-gluconate, propionate, *cis*- and *trans*-aconitate, 4-aminobutyrate, itaconate, mesaconate, β-alanine, L-aspartate, L-leucine, L-ornithine, L-serine, *N*-acetylglucosamine, cellobiose, D-mannose, α-melibiose, L-rhamnose, salicin, trehalose, adonitol, *myo*-inositol, maltitol, putrescine, adipate, azelate, suberate, L-histidine, L-phenylalanine and L-tryptophan, on the basis of the method described by Kämpfer *et al.* (1991). Utilization of D-glucose and maltose became positive after incubation for 7 days for *D. ficus* CC-FR2-10^T and utilization of acetate became positive after incubation for 7 days for *D. mumbaiensis* DSM 17424^T.

DNA–DNA hybridization experiments were performed with strains *D. ficus* CC-FR2-10^T and *D. mumbaiensis* DSM 17424^T. DNA isolation and DNA–DNA hybridization were done as described previously (Ziemke *et al.*, 1998). Results of the DNA–DNA cross-hybridization yielded a relatedness of 75.4 %, whereas reciprocal hybridization gave a higher value of 76.6 %.

Based on the presented results, it is proposed to unite the species *Deinococcus mumbaiensis* and *Deinococcus ficus*.

Abbreviations: pNA, *p*-nitroanilide; pNP, *p*-nitrophenyl.

Table 1. Cellular fatty acid contents of *D. ficus* CC-FR2-10^T and *D. mumbaiensis* DSM 17424^T

Strains: 1, *D. ficus* CC-FR2-10^T; 2, *D. mumbaiensis* DSM 17424^T. Values are percentages of total fatty acids. Minor fatty acids (<0.5%) are not shown.

Fatty acid	1	2
iso-C _{15:1} F	1.0	1.7
iso-C _{15:0}	3.7	4.8
C _{15:1} ω8c	4.0	2.3
C _{15:1} ω6c	6.6	4.3
C _{15:0}	5.3	3.1
C _{16:1} ω9c	3.8	3.2
Summed feature 3*	19.0	17.9
C _{16:0}	8.0	7.3
iso-C _{17:1} ω9c	15.5	24.7
iso-C _{17:0}	6.3	9.3
C _{17:1} ω8c	18.0	14.3
C _{17:1} ω6c	1.9	2.0
C _{17:0}	4.1	3.3
C _{18:1} ω9c	0.8	1.0
C _{18:1} ω7c	0.6	0.9

*Summed feature 3 contains C_{16:1}ω7c and/or iso-C_{15:0} 2-OH.

According to Rules 38, 42 and 24b(2) of the Bacteriological Code (Lapage *et al.*, 1992), the name *Deinococcus ficus* has priority and hence should be used for the unified taxon.

Emended description of *Deinococcus ficus* Lai *et al.* 2006

The characteristics of this species are as described by Lai *et al.* (2006), with the following amendment. Results of carbon substrate utilization depend heavily on the method. With the Biolog method, based on dehydrogenases (Lai *et al.*, 2006), many more utilization tests (e.g. *N*-acetyl-D-glucosamine, L-arabinose, D-galactose, D-gluconic acid, D-mannitol, D-mannose, melibiose, methyl β-D-glucoside,

raffinose, L-rhamnose, D-sorbitol, sucrose, trehalose, D-xylose, β-hydroxybutyric acid, *p*-hydroxyphenylacetic acid, L-lactic acid, D-malic acid, propionic acid, pyruvic acid, succinic acid and L-asparagine; Lai *et al.*, 2006) are positive than with the growth-based method based on the increase of turbidity (see above). The type strain is CC-FR2-10^T (=CCUG 53391^T =CIP 108832^T).

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