Algibacter mikhailovii sp. nov., a novel marine bacterium of the family Flavobacteriaceae, and emended description of the genus Algibacter

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A novel marine bacterium, designated strain KMM 6171T, was subjected to taxonomic analysis by using a polyphasic approach. Colonies were yellow-pigmented and cells were Gram-negative, heterotrophic rods displaying slow gliding motility. 16S rRNA gene sequence analysis indicated that strain KMM 6171T was closely related to the genus Algibacter, a member of the family Flavobacteriaceae, with sequence similarity of 96.7–96.8 %. The predominant cellular fatty acids were iso-C15 : 1, iso-C15 : 0, anteiso-C15 : 0, C15 : 0, iso-C15 : 0 3-OH, iso-C17 : 0 3-OH and summed feature 3, comprising C16 : 1ω7c and/or iso-C15 : 0 2-OH. The DNA G+C content was 35.1 mol%. On the basis of the phenotypic, genotypic, chemotaxonomic and phylogenetic data, strain KMM 6171T represents a novel species of the genus Algibacter, for which the name Algibacter mikhailovii sp. nov. is proposed. The type strain is KMM 6171T (=KCTC 12710T =LMG 23988T). An emended description of the genus Algibacter based on the new data is also given.
Algibacter lectus with 16S rRNA gene sequence similarity of 96.7–96.8 %, suggesting that strain KMM 6171 T may represent a novel species in the genus Algibacter according to the recommendations of Stackebrandt & Goebel (1994).

DNA was isolated following the method of Marmur (1961) and the DNA G+C content was determined by the thermal denaturation method (Marmur & Doty, 1962). The DNA G+C content of KMM 6171T was 35.1 mol%.

Analysis of fatty acid methyl esters of strain KMM 6171T was carried out according to the standard protocol of the Microbial Identification System (Microbial ID), except that the biomass was obtained from culture grown on marine agar 2216 at 25 °C for 48 h.

The fatty acid composition of strain KMM 6171 T was characterized by the predominance of branched-chain saturated and unsaturated fatty acids, namely iso-C15:1, iso-C15:0, anteiso-C15:0, C15:0, iso-C15:0 3-OH, iso-C17:0 3-OH and summed feature 3, comprising C16:1ω7c and/or iso-C15:0 2-OH. A similar fatty acid composition was reported for the type strain of A. lectus (Nedashkovskaya et al., 2004).

Phenotypic analysis was performed by using methods described previously (Nedashkovskaya et al., 2003, 2004). API 20E, API 20NE and API ZYM galleries (bioMérieux) were also used for studying the phenotypic features of the strain according to the manufacturer’s instructions, except that the galleries were incubated at 28 °C.

Cells of strain KMM 6171T were heterotrophic, Gram-negative, motile by gliding, agarolytic and formed pale-yellow colonies. Other physiological and biochemical characteristics are listed in the species description and Table 1. Similar to A. lectus, the novel bacterium was oxidase-, catalase-, β-galactosidase- and agarase-positive, and was able to grow in media containing 1–6 % NaCl. However, strain KMM 6171T could be readily distinguished from A. lectus by the presence of nitrate reductase and DNase activities, by the absence of amylase and Tween esterase activities, and by its inability to form acid from carbohydrates.

Consequently, significant molecular distinctiveness and clear phenotypic differences support the description of strain KMM 6171 T as a novel species of the genus Algibacter, for which the name Algibacter mikhailovii sp. nov. is proposed.

The representatives of the single species of the genus Algibacter, A. lectus, can ferment D-glucose. Consequently, A. lectus was characterized as a facultatively anaerobic organism in the genus description (Nedashkovskaya et al., 2004). Conversely, the novel isolate is strictly aerobic and unable to ferment D-glucose. In addition, fatty acid C15:1ω6c, one of the major components of A. lectus, only amounts to 1.7 % in strain KMM 6171T. These facts justify an emendation of the description of the genus Algibacter.

**Description of Algibacter mikhailovii** sp. nov.

Algibacter mikhailovii (mik.ha’i.lo.vi.i. N.L. masc. gen. n. mikhailovii of Mikhailov, in honour of Valery V. Mikhailov, a Russian microbiologist, for his contributions to the development of marine microbiology).

Cells range from 0.3 to 0.4 μm in width by 2 to 10 μm in length and move slowly by gliding. On marine agar colonies are circular, 1–3 mm in diameter after 72 h of incubation at 25 °C, convex, shiny, sunken into the agar and pale-yellow-pigmented. Requires Na+ ions for growth. Growth occurs at 4–37 °C and with 1–6 % NaCl. Optimal growth is observed at 23–25 °C and with 2–3 % NaCl. Heterotrophic, strictly aerobic. D-Glucose is not fermented. Flexirubin-type pigments are not produced. Oxidase, catalase, β-galactosidase and alkaline phosphatase activities...
Table 1. Differential phenotypic characteristics of Algibacter species

All strains were positive for: gliding motility; oxidase, catalase, β-galactosidase and alkaline phosphatase activities; requirement of NaCl for growth; growth at 1–6% NaCl and at 4–35 °C; hydrolysis of agar and gelatin; utilization of D-glucose, D-lactose and D-mannose; susceptibility to carbenicillin, starch, Tweens 20, 40 and 80; are present. Decomposes agar, aesculin, gelatin and DNA. Does not hydrolyse casein, starch, Tweens 20, 40 and 80, cellulose (CM-cellulose and filter paper), chitin or Tween 80; acid formation from L-arabinose, D-lactose, D-melibiose, D-raffinose, L-rhamnose, l-sorbose, glycerol, citrate, fumarate, malate, adonitol, inositol, mannitol and sorbitol; utilization of inositol, citrate and malonate; susceptibility to ampicillin, benzylpenicillin, gentamicin, kanamycin, neomycin, polymixin B and streptomycin. Data are from Nedashkovskaya et al. (2004) and this study.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>A. mikhailovii</th>
<th>A. lectus</th>
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<tbody>
<tr>
<td>Fermentation of D-glucose</td>
<td>–</td>
<td>+</td>
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<tr>
<td>Nitrate reduction</td>
<td>+</td>
<td>–</td>
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<tr>
<td>Growth at 37 °C</td>
<td>+</td>
<td>–</td>
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<tr>
<td>Hydrolysis of:</td>
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<tr>
<td>Starch</td>
<td>–</td>
<td>+</td>
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<tr>
<td>Tween 40</td>
<td>–</td>
<td>+</td>
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<tr>
<td>DNA</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Acid production from carbohydrates</td>
<td>–</td>
<td>+</td>
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<tr>
<td>Utilization of:</td>
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<tr>
<td>Sucrose</td>
<td>–</td>
<td>+</td>
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<tr>
<td>Arabinose and sorbitol</td>
<td>+</td>
<td>–</td>
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<tr>
<td>Susceptibility to tetracycline</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>DNA G + C content (mol%)</td>
<td>35.1</td>
<td>31–33</td>
</tr>
</tbody>
</table>

are present. Decomposes agar, aesculin, gelatin and DNA. Does not hydrolyse casein, starch, Tweens 20, 40 and 80, cellulose (CM-cellulose and filter paper), chitin or urea. Acid is not produced from arabinose, cellobiose, fructose, galactose, glucose, lactose, maltose, melibiose, raffinose, rhamnose, sucrose, xylose, N-acetyl-D-glucosamine, glycerol, inositol and mannitol. Arabinose, glucose, lactose, mannose and sorbitol are utilized, but sucrose, adonitol, dulcitol, mannitol and inositol are not. According to API galleries, maltose, gluconate, caprate, adipate, malate, citrate and phenylacetate are not utilized; arginine dihydrolase activity is absent, and acid is not produced from amygdalin. Esterase (C4), esterase lipase (C8), leucine arylamidase, valine arylamidase, cysteine arylamidase, trypsin, acid phosphatase, naphthol-AS-BI-phosphohydrolase, x- and β-glucosidases and N-acetyl-β-glucosidase activities are present, but lipase (C14), x-chymotrypsin, x-galactosidase, β-glucuronidase, x-mannosidase or x-fucosidase activities are absent. Nitrate is reduced to nitrite. Indole, H2S and acetoin (Voges–Proskauer reaction) are not produced. Susceptible to carbencillin, lincomycin, oleandomycin and tetracycline. Resistant to ampicillin, benzylpenicillin, gentamicin, kanamycin, neomycin, polymixin B and streptomycin. The fatty acids amounting to more than 1% of total are iso-C15:1 (13%), anteiso-C15:0 (6.4%), C15:0 (7%), C15:1ω6c (1.7%), iso-C16:1 H (2%), C16:0 10 methyl (2.1%), C16:0 (2.3%), iso-C15:0 3-OH (5.8%), C15:0 2-OH (2.4%), C15:0 3-OH (1.3%), C16:0 3-OH (1.4%), iso-C17:0 3-OH (13%), C17:0 2-OH (2.4%), C18:1ω5c (1.8%) and summed feature 3 (22.2%), consisting of iso-C15:0 2-OH and/or C16:1ω7c. The DNA G+ C content is 35.1 mol%.

The type strain, KMM 6171T (=KCTC 12710T=LMG 23988T), was isolated from a sea urchin, Strongyllocentrotus intermedius, collected in Troitsa Bay, East Sea.

Emended description of the genus Algibacter

Nedashkovskaya et al. 2004

The description of the genus Algibacter is as given by Nedashkovskaya et al. (2004) and this study, with the following amendments. Some strains can ferment D-glucose. The main cellular fatty acids are straight-chain unsaturated and branched-chain unsaturated iso-C15:0, anteiso-C15:0, iso-C15:1, C15:0, iso-C15:0 3-OH, iso-C17:0 3-OH and summed feature 3, consisting of iso-C15:0 2-OH and/or C16:1ω7c. As determined by 16S rRNA gene sequence analysis, the genus Algibacter is a member of the family Flavobacteriaceae, phylum Bacteroidetes. The type species is A. lectus.

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References


