A DESCRIPTION OF THE TYPE STRAIN OF PSEUDOMONAS MALTOPHILIA

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SUMMARY. A morphological and physiological description of the type strain of Pseudomonas maltophilia Hugh and Ryschenkow 1960 is presented. Photomicrographs record formalin treated and nontreated polar multitrichous flagella in stained preparations. A brief review is presented of several nomenclaturally unacceptable names which have been applied to strains of P. maltophilia.

Pseudomonas maltophilia was first described in an abstract (Hugh and Ryschenkow 1960). The description was later amended by Hugh and Ryschenkow (1961). A type strain was designated in the latter report. The type strain carries several corresponding numbers: 810-2, RH 1168, ATCC (American Type Culture Collection, Washington, D.C.) 13637, NRC (Canadian National Research Council, Ottawa) 729, NCTC (National Collection of Type Cultures, London) 10257, NCIB (National Collection of Industrial Bacteria, Aberdeen) 9203, MDB (Microbiology Department, Faculty of Natural Sciences, Brno) BS 1640.

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The type strain was isolated by the senior author in Washington, D C. on 30 April 1958 from an oropharyngeal swab taken from a patient with nonulcerated, epidermoid cancer of the floor of the mouth. The patient had not received antibiotic therapy. It was a Gram-negative rod about 0.5 x 2.5 μ. A capsule was not conspicuous. Spores were not formed. It was motile with a tuft of polar flagella. The number of flagella per cell varied from 1 to 6. Generally the cells showed 3 or 4 polar flagella. Photomicrographs illustrate the polar multitrichous flagellation of P. maltophilia ATCC 13637, the type strain. Figure 1 shows a broth culture cell with 4 flagella stained without formalin fixation. Figure 2 shows a broth culture cell with 3 flagella stained after formalin fixation. The wavelength of the flagella was approximately 2.4 μ. Formalin appeared to increase the amplitude of the flagella. Eight photomicrographs illustrate the flagellar morphology of P. maltophilia ATCC 13843 (RH 611), see Hugh and Ryschenkow 1961.

Figure 1. Pseudomonas maltophilia ATCC 13637 showing the polar multitrichous flagellation characteristic of the organism in broth culture without formalin fixation. Leifson flagella stain, X 2,000.

Figure 2. Pseudomonas maltophilia ATCC 13637 showing the polar multitrichous flagellation characteristic of the organism in broth culture after formalin fixation. Leifson flagella stain, X 2,000.
BACTERIOLOGICAL NOMENCLATURE
AND TAXONOMY

The type strain was a strict aerobe which produced a dense turbidity in peptone broth in 18 to 24 hours at temperatures of 22° and 37°. Growth on agar medium after two days of incubation had an opaque grey appearance with a faint yellow cast. The yellow color appeared in the growth but not in the medium. The pigment was not chloroform soluble. The colonies on deoxycholate agar were discrete and grey. Sheep erythrocytes in infusion agar base around isolated surface colonies were not hemolyzed. Peptone broth at pH 4.5 did not support significant growth at 22° or 37°.

Alkali accumulated in OF base medium (Hugh and Leifson, 1953 - Difco 0688) with the following carbon compounds: adonitol, arabinose, cellobiose, dulcitol, 3% ethanol, galactose, glycerol, inositol, inulin, lactose, mannitol, melezitose, melibiose, raffinose, rhamnose, d-ribose, salicin, sorbitol, sucrose, trehalose, and xylose. The indole, methyl red, acethylmethyl carbinol, Simmons' citrate, indophenol oxidase, hydrogen sulfide (Kligler's), nitrate reduction to nitrogen gas, phenylalanine deaminase, urea (Christensen's), and lysine, arginine, and ornithine (Moller's) tests were negative.

Acid promptly accumulated at the unsealed surface of OF base medium containing fructose, maltose, and mannose. Acid was not apparent in the presence of these three carbohydrates when the medium was sealed with petrolatum. The unsealed surface of OF dextrose medium was alkaline after 24 hours but slowly became weakly acid after 5 days' incubation. Christensen's citrate, catalase, charcoal gelatin, lysine decarboxylase (ninhydrin), nitrate reduction to nitrite, and malonate tests were positive. Potassium cyanide broth was moderately turbid after 2 days' incubation. The organism failed to grow in the 2-ketogluconate medium. The above description of the type strain of *P. maltophilia* was based on procedures described and referred to by Hugh and Ryschenkow (1961).

Apparently the first name applied to organisms conforming to the above description was *Xanthomonas maltophilia* proposed by Hugh (1953) in an unpublished dissertation. However, under these conditions the name *X. maltophilia* must be regarded as not effectively published, and without standing in bacteriological nomenclature. Dr. A. C. Hayward, at the Commonwealth Mycological Institute in England, on 9 January 1963, in a personal communication, stated that
this species is correctly placed in the genus *Pseudomonas* rather than *Xanthomonas*.

The following twelve strains, which have been encountered in the literature, were obtained and subsequently identified as *P. maltophilia*. None of these cultures are type strains.

It is generally agreed that motile species of the genus *Alcaligenes* have peritrichous flagella; therefore, the name *Alcaligenes faecalis* is unsuitable for strains to which the name *Pseudomonas maltophilia* has been applied. The history of the name *Alcaligenes bookeri* has been reviewed and this organism was considered to be a species *incertae sedis* (Hugh and Ryschenkow 1961). Therefore, the epithet *bookeri* should not be applied to *Pseudomonas maltophilia*. The name *Pseudomonas alcaligenes* was applied to five strains of the taxon under consideration (Komagata 1961, Iizuka and Komagata 1962). These workers did not give a literature reference for the name *Pseudomonas alcaligenes*.

It appears that Monias (1928) was the first to use the name *Pseudomonas alcaligenes*. He applied this name to Gram-negative rod-shaped organisms with polar flagella which did "not ferment ANY carbohydrates." This suggests that Monias did not detect acid production from maltose by his 10 strains of *Pseudomonas alcaligenes*. *Pseudomonas maltophilia* ATCC 13637, the type strain, and the five strains of *Pseudomonas alcaligenes* (P-1, P-7, P-7-2, P-19, P-31-2) received from Komagata are polar multitrichous and readily produced oxidative acidity from maltose. Komagata's strains have been identified as *P. maltophilia*. The name *Pseudomonas alcaligenes* Monias 1928 is not an earlier synonym of *Pseudomonas maltophilia* Hugh and Ryschenkow 1961. Komagata now agrees that the 5 strains labelled *Pseudomonas alcaligenes* should be named *Pseudomonas maltophilia* (personal communication dated 20 February 1963).
<table>
<thead>
<tr>
<th>RH Number</th>
<th>Received with the following designations</th>
<th>Other Strain Numbers</th>
<th>Reference</th>
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<tbody>
<tr>
<td>1395</td>
<td>Pseudomonas ?</td>
<td>K-7, M215</td>
<td>Moore and Pickett 1960</td>
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<td>1410</td>
<td>Pseudomonas sp.</td>
<td>K-8, M237</td>
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<td>431</td>
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<td>K-8, M275, Ulrich 282</td>
<td>Moore and Pickett 1960, Ulrich and Needham 1953</td>
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<td>K-10, M274, Ulrich 249</td>
<td>Moore and Pickett 1960, Ulrich and Needham 1953</td>
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<td>229</td>
<td>Bacterium bookeri</td>
<td>NCTC 6572</td>
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<td>1929</td>
<td>Alcaligenes faecalis</td>
<td>MDB 09, IEB 1/48</td>
<td>Microbiology Department, Faculty of Natural Sciences, University of J. E. Purkyne, Brno; Institute of Epidemiology and Bacteriology, Prague, Czechoslovakia.</td>
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<td>1875</td>
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<td>139</td>
<td>Alcaligenes faecalis</td>
<td></td>
<td>Phillips and Hanel 1950</td>
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REFERENCES


