Cross-Reaction of Stenotrophomonas and Xanthomonas Species in a 23S rRNA Gene-Directed PCR for Detection of S. maltophilia


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Title: Cross-reaction with *Stenotrophomonas* and *Xanthomonas* species in a 23S rDNA-directed PCR for the detection of *S. maltophilia*

Niki F. Foster*

*Discipline of Microbiology & Immunology, School of Biomedical, Biomolecular and Chemical Sciences, The University of Western Australia, Queen Elizabeth II Medical Centre, Nedlands, Australia*

Gerald B. Harnett

*Division of Microbiology and Infectious Diseases, PathWest Laboratory Medicine WA, Queen Elizabeth II Medical Centre, Nedlands, Australia*

Thomas V. Riley

*Discipline of Microbiology & Immunology, School of Biomedical, Biomolecular and Chemical Sciences, The University of Western Australia, Queen Elizabeth II Medical Centre, Nedlands, Australia*

Barbara J. Chang

*Discipline of Microbiology & Immunology, School of Biomedical, Biomolecular and Chemical Sciences, The University of Western Australia, Queen Elizabeth II Medical Centre, Nedlands, Australia*

*Phone: +61-8-9346-2250
Fax: +61-8-9346-2912
E-mail: nfoster@cyllene.uwa.edu.au.*
*Stenotrophomonas maltophilia* is an opportunistic pathogen that occupies a variety of niches both inside and outside hospitals, mostly in moist environments (1). Whitby et al. recently developed species-specific PCR (SS-PCR) primers directed at a region of the *S. maltophilia* 23S rRNA gene to overcome problems with definitive identification of the species in the clinical laboratory (5). Several pulmonary pathogens including *Alcaligenes xylosoxidans*, *Burkholderia* sp., *Elizabethkingia meningosepticum*, *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Moraxella catarrhalis*, *Proteus mirabilis*, *Pseudomonas* sp. and *Ralstonia* sp. were tested in this (5) and other (3) studies. In addition, environmental strains of *E. meningosepticum*, *Pseudomonas* sp., *Sphingomonas paucimobilis* and *Wautersia paucula* have been tested and no cross-reactivity was reported (2). In the present study, we examined cross-reactions with other *Stenotrophomonas* species and closely related genera occupying similar environmental niches.

Crude bacterial DNA extracts from *B. cepacia* genovar I ATCC 25416, *P. aeruginosa* NCTC 10662, *S. acidaminiphila* ATCC 700916T, *S. maltophilia* ATCC 13637T, *S. nitritireducens* ATCC BAA-12T, *S. rhizophila* ATCC BAA-473T, *Xanthomonas axonopodis* pv. *citri* DAR 65864, and *Xanthomonas campestris* pv. *campestris* DAR 65808 (*Xanthomonas* strains were provided by the Australian Collection of Plant Pathogenic Bacteria, Orange, Australia), were prepared as described elsewhere (2). The SS-PCR protocol described by Whitby et al. (5) was used with modifications. The reaction mixture (50 µl) contained 1 × reaction buffer II (Applied Biosytems, USA), 3 mM MgCl2, 200 µM of each deoxyribonucleotide triphosphate, 1.25U AmpliTaq Gold® polymerase (Applied Biosystems), 1 µM of each primer (SM1 and SM4) and 5 µl of DNA extract. Amplifications were performed...
on a Gene Amp® PCR System 2700 thermocycler (Applied Biosystems) as follows: 95°C for 10 min, then 45 cycles of 94°C for 30 s, 58°C for 30 s and 72°C for 60 s, with final extension 72°C for 7 min. A product of approximately 531-bp was expected.

All *Stenotrophomonas* and *Xanthomonas* species tested gave a positive reaction in the *S. maltophilia* SS-PCR. *P. aeruginosa* NCTC 10662 and *B. cepacia* ATCC 25416 were PCR-negative; clinical isolates of *P. aeruginosa* and *B. cepacia* genomovar I were PCR-negative elsewhere (5). Results were reproducible over two or more replicates. Sequencing of products was performed (ABI PRISM 3100 Avant Genetic Analyzer, Applied Biosystems) and the *S. acidaminiphila* ATCC 700916T, *S. nitritireducens* ATCC BAA-12T, *S. rhizophila* ATCC BAA-473T, *Xanthomonas axonopodis* pv. *citri* DAR 65864, and *Xanthomonas campestris* pv. *campestris* DAR 65808 sequences have the GenBank accession numbers EU878276-EU878280. All were highly homologous to the 23S rRNA partial gene sequence of *S. maltophilia* ATCC 13637, GenBank accession number AF273255 (5) (Table 1). The partial nucleotide sequence of the product from ATCC 13637 (481 bp) was 99% homologous to AF273255, with a single polymorphism (A567G).

The *S. maltophilia* 23S target sequence from GenBank sequence AF273255 (nucleotide positions 62 to 593) was used to query the GenBank database to identify other possible cross-reactivity of the PCR. *S. maltophilia* K279a genome (AM743169) and 23S rRNA genes from three other *S. maltophilia* had 97-99% identity to the target sequence (532 nucleotides) (E value, 0.0). The next highest homology (93% identity; 99% query coverage; E value, 0.0) was in 23S rDNA from
complete genome sequences of X. axonopodis pv. citri (1 strain), X. campestris pv. campestris (3), X. campestris pv. vesicatoria (1), and X. oryzae pv. oryzae (3). A single mismatch (A:C; primer:template) exists at the 3’-terminus of the forward primer (SM1) amongst Xanthomonas spp., while this mismatch and a second internal mismatch with the reverse primer (SM4) (T:G) exists in Xylella fastidiosa (23S rDNA from complete genome sequences of four strains; 89% identity; 99% query coverage; E value, 0.0) (Figure 1). Single internal mismatches and single A:C mismatches at the 3’-terminal nucleotide of a primer may not reduce amplification efficiency (4). Though 23S rRNA gene sequences from P. aeruginosa, P. fluorescens and P. stutzeri (PCR-negative species (5)) were of the next highest identity to the query sequence (83-85% identity; 99% query coverage; E value, 2e-163 to 6e-158), they had more significant mismatches in their primer binding regions.

S. maltophilia is the only Stenotrophomonas species to cause infection in humans. With the potential for use of Stenotrophomonas species as biological control agents (1, 6), it is important to be able to distinguish between S. maltophilia and other apparently less harmful Stenotrophomonas species sharing the same habitat and possessing similar biological control capacity. Molecular methods are increasingly used to identify or confirm the identity of bacterial isolates. Our findings emphasize the need to thoroughly evaluate SS-PCR methods using related species, particularly when such species may share an ecological niche.
References


TABLE 1. Sequence similarity of SS-PCR products of *Stenotrophomonas* and *Xanthomonas* spp. to *S. maltophilia* ATCC 13637 23S rRNA partial gene sequence (GenBank accession number AF273255 (5)).

<table>
<thead>
<tr>
<th>Strain</th>
<th>Sequence length&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Similarity to AF273255&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Query coverage</td>
</tr>
<tr>
<td><em>S. maltophilia</em> ATCC 13637</td>
<td>481 bp</td>
<td>100%</td>
</tr>
<tr>
<td><em>S. acidaminiphila</em> ATCC 700916</td>
<td>483 bp</td>
<td>100%</td>
</tr>
<tr>
<td><em>S. rhizophila</em> ATCC BAA-473</td>
<td>423 bp</td>
<td>100%</td>
</tr>
<tr>
<td><em>S. nitritireducens</em> ATCC BAA-12</td>
<td>486 bp</td>
<td>100%</td>
</tr>
<tr>
<td><em>Xanthomonas axonopodis</em> pv. <em>citri</em> DAR 65864</td>
<td>257 bp</td>
<td>100%</td>
</tr>
<tr>
<td><em>Xanthomonas campestris</em> pv. <em>campestris</em> DAR 65808</td>
<td>133 bp</td>
<td>100%</td>
</tr>
</tbody>
</table>

<sup>a</sup> Sequence length is of edited sequence confirmed by forward and reverse sequencing; primer and ambiguous terminal sequences were not included.

<sup>b</sup> Determined by BLASTn search of GenBank database (June 2008)
FIGURE 1. Alignment of the SM1 (A) and SM4 (B) primer sequences with high scoring sequences from a BLASTn query (June 2008) of the AF273255 SS-PCR target sequence. Sequences known to be from the same strain were not included. Dots indicate identity with the primer sequence.