Cellular Fatty Acid Composition of *Corallococcus coralloides*

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**Abstract.** The fatty acid composition of five strains of *Corallococcus coralloides* and three reference species of *Myxococcus* were determined by gas–liquid chromatography. Methyl esters of fatty acid containing from 12 to 22 carbon atoms were identified. The major fatty acids present were C15 and C17 saturated branched chain, and both C16 saturated and unsaturated straight chain acids. The C17 saturated branched and straight chain acids, which were in valuable concentration in species of *Myxococcus*, were not, however, detected in all strains of *C. coralloides*. The application of these results in the distinction of *C. coralloides* from the genus *Myxococcus* is discussed.

The application of gas–liquid chromatography of fatty acids for the classification of bacteria was first attempted by Abel et al. [1], and many laboratories are currently using gas–liquid chromatography to study the cellular fatty acid composition of microorganisms because of its convenience and usefulness. Chemotaxonomic characteristics, such as the cellular fatty acid composition, provide valuable information for the differentiation and classification of bacterial groups. As regards the fruiting myxobacteria, little information on the lipid composition is available except for a few reports [5, 9, 12].

Classification of myxobacteria rests almost entirely on morphological characteristics in part for historical reasons and in part because most of the physiological information is restricted to very few strains of myxobacteria, mostly *Myxococcus xanthus* [7, 11].

In previous work, we have found that the cellular fatty acid composition of a strain of *Corallococcus coralloides* differed from *Myxococcus* species. To evaluate whether these could be used as markers for differentiation of *Corallococcus coralloides* from the genus *Myxococcus*, we have studied the cellular fatty acid composition of five strains of *Corallococcus coralloides* in order to clarify the relationships between *Myxococcus* and *Corallococcus*.

**Materials and Methods**

**Organisms.** The five strains of *Corallococcus coralloides*—Cc-10, Cc-11, Cc-14, Cc-20, and Cc-410—were kindly supplied by Dr. H. Reichenbach (Braunschweig, FRG).

The reference species of *Myxococcus* were obtained from the American Type Culture Collection (ATCC) and were as follows: *M. fulvus* ATCC 23093, *M. virescens* ATCC 25203, and *M. xanthus* ATCC 25232.

**Culture medium.** The bacteria were grown on a rotatory shaker at 30°C in 500-ml Erlenmeyer flasks containing 80 ml CT medium [4]. The composition of medium was as follows (g/liter): Casitone (Difco), 20; KH2PO4, 1.5; KH2PO4, 0.2; MgSO4, 2; and pH 7.6, adjusted with KOH. The flasks were inoculated from cultures in the exponential phase.

**Cell preparation.** Vegetative cells during the stationary growth phase, when the fatty acid composition is reported to be most stable [6], were harvested by centrifugation at 10,000 rpm in the cold, followed by washing twice with cold saline. The washed cells were then lyophilized.

**Fatty acid analysis.** Lyophilized cells (50 mg) were submitted to fatty acid analysis as reported previously [8].

**Results and Discussion**

Methyl esters of fatty acid containing from 12 to 22 carbon atoms were identified in the extracts of whole bacteria (Table 1). The major acids present included C15 and C17 saturated branched chain, and both C16 saturated and unsaturated straight chain acids. Ware and Dorkin [12] reported a similar pattern of fatty acids for *Myxococcus xanthus*.

All *Corallococcus coralloides* strains examined presented a similar cellular fatty acid composition, and we want to emphasize that in all strains of *C. coralloides* the C17 saturated branched and straight chain acids, which were in appreciable amounts in
Table 1. Cellular fatty acid composition of strains of Corallococcus coralloides and species of Myxococcus

<table>
<thead>
<tr>
<th>Strain</th>
<th>12:0&lt;sup&gt;a&lt;/sup&gt;</th>
<th>13:0</th>
<th>14:0</th>
<th>14:0</th>
<th>15:0</th>
<th>15:0</th>
<th>16:0</th>
<th>16:0</th>
<th>16:1</th>
<th>17:0</th>
<th>17:0</th>
<th>17:0</th>
<th>18:0</th>
<th>18:1</th>
<th>19:0</th>
<th>19:0</th>
<th>20:0</th>
<th>21:0</th>
<th>22:0</th>
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<tbody>
<tr>
<td>C. coral-</td>
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<tr>
<td>Cc-10</td>
<td>2.15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.75</td>
<td>3.19</td>
<td>2.97</td>
<td>26.58</td>
<td>ND&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.70</td>
<td>10.68</td>
<td>25.65</td>
<td>ND</td>
<td>ND</td>
<td>2.86</td>
<td>1.65</td>
<td>0.74</td>
<td>ND</td>
<td>6.72</td>
<td>2.01</td>
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<td>1.42</td>
<td>1.72</td>
<td>2.31</td>
<td>27.58</td>
<td>ND</td>
<td>1.09</td>
<td>12.91</td>
<td>23.96</td>
<td>ND</td>
<td>ND</td>
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<td>3.42</td>
<td>0.41</td>
<td>ND</td>
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<tr>
<td>Cc-14</td>
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<td>T</td>
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<td>18.13</td>
<td>ND</td>
<td>ND</td>
<td>5.32</td>
<td>4.12</td>
<td>T&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>0.73</td>
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<td>ND</td>
<td>2.03</td>
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<td>ND</td>
<td>ND</td>
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<td>T&lt;sup&gt;d&lt;/sup&gt;</td>
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<tr>
<td>Cc-410</td>
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<td>4.91</td>
<td>23.75</td>
<td>ND</td>
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<td>19.76</td>
<td>18.89</td>
<td>ND</td>
<td>ND</td>
<td>6.51</td>
<td>6.53</td>
<td>T&lt;sup&gt;d&lt;/sup&gt;</td>
<td>ND</td>
<td>3.14</td>
<td>5.22</td>
<td>5.54</td>
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Myxococcus

<table>
<thead>
<tr>
<th></th>
<th>fatty acid (%) wt/wt total</th>
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<tbody>
<tr>
<td>fulbus</td>
<td></td>
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<tr>
<td>virescens</td>
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<tr>
<td>xanthus</td>
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</table>

<sup>a</sup> Number to left of colon refers to number of carbon atoms; number to right refers to number of double bonds; br-, branched acid; and cy-, cyclopropane acid.

<sup>b</sup> Values represent the means of three different analyses of fatty acid samples from three independent batches of cells. Standard deviations (± 0.03 – 0.95).

<sup>c</sup> ND, fatty acid not detected.

<sup>d</sup> T, contents of less than 0.1%.

the species of Myxococcus studied, were not detected. To our knowledge this is the first report on the fatty acid composition of C. coraloides, and it is therefore impossible to compare the results with data for other strains.

Chemotaxonomic characteristics provide valuable information for the differentiation of bacterial groups [2, 3]. In the taxonomy of myxobacteria about 30 species are recognized, distinguished mainly on the basis of morphological characters. The definitions of species are not always satisfactory, and a reinvestigation with modern taxonomic methods is urgently needed [10].

We show in this study that strains of M. fulbus, M. virescens, and M. xanthus yield similar fatty acid composition, which showed several minor differences that are probably not significant enough to provide a reliable differentiation scheme. The strains of C. coraloides differed from the other three strains of Myxococcus by the fatty acid pattern. Reichenbach and Dworkin [11] excluded Myxococcus coraloides from the genus Myxococcus because fruiting bodies are tough, cartilagineous columns or ridged, and suggest a new generic name, Corallococcus. We also suggest that the exclusion of Myxococcus coraloides from the genus is deemed reasonable on the basis of cellular fatty acid composition. The difference in both C17 saturated branched and straight chain acids was sufficiently large and reproducible to be used as markers for differentiation of Corallococcus coraloides of the genus Myxococcus. Further studies are needed to determine the taxonomic application of these results.

**ACKNOWLEDGMENTS**

We would like to thank Dr. H. Reichenbach for providing us with the Corallococcus coraloides strains.

**Literature Cited**

9. Noren B, Odham G (1973) Antagonistic effects of Myxococ-