Evaluation of BBL CHROMagar O157 versus Sorbitol-MacConkey Medium for Routine Detection of Escherichia coli O157 in a Centralized Regional Microbiology Laboratory

D. L. Church,1,2* D. Emshey,1 H. Semeniuk,1 T. Lloyd,1 and J. D. Pitout1,2

Calgary Laboratory Services (CLS)1 and Departments of Pathology and Laboratory Medicine and Medicine, University of Calgary,2 Calgary, Alberta, Canada

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The performance of BBL CHROMagar O157 (CHROM) versus that of sorbitol-MacConkey (SMAC) media for detection of Escherichia coli O157 was determined for a 3-month period. Results for 27/3,116 (0.9%) stool cultures were positive. CHROM had a higher sensitivity (96.30%) and negative predictive value (100%) and a better diagnostic efficiency than SMAC. Labor and material costs decreased when CHROM was used.

Escherichia coli O157:H7 strains are the most prevalent group of Shiga toxin (Stx)-producing E. coli (STEC) worldwide (4, 11, 13, 23, 25). This serotype causes a broad range of conditions, from mild, nonbloody diarrhea to severe hemorrhagic colitis, hemolytic uremic syndrome, and death (3, 12, 16, 21, 23, 25). Transmission frequently occurs through ingestion of raw or undercooked beef, but other contaminated foods and water have also been implicated, and person-to-person transmission also occurs (1, 4, 7, 16, 19–21, 24, 25, 26).

Our centralized regional clinical microbiology laboratory routinely tests all stool cultures for E. coli O157, using its inability to ferment sorbitol on sorbitol-MacConkey (SMAC) agar (PML Microbiologies), a medium where sorbitol is substituted for the lactose in the standard MacConkey formulation (11, 14, 22). However, E. coli O157 infections may be missed on SMAC because some strains ferment sorbitol and cannot be differentiated from normal intestinal flora (2, 11). Chromogenic agar was recently marketed for improved detection of E. coli O157. Colonies of E. coli O157:H7 growing on BBL CHROMagar O157 (CHROM) (Becton Dickinson) produce a mauve color due to chromogenic substrates in the medium, thus allowing presumptive identification from the primary isolation plate and differentiation from other organisms (5). This study compared the performance and diagnostic efficacy of these two types of selective and differential solid media for the routine detection of E. coli O157 during the summer months when infections are most prevalent in our region.

Calgary Laboratory Services (CLS) is a large integrated medical laboratory company that provides clinical services to the Calgary Health Region (CHR), one of the largest integrated healthcare regions in Canada (population, 1.2 million). Clinical microbiology services for hospitalized and ambulatory patients are delivered 24 h a day, 7 days a week, through a centralized laboratory located in the community (9). The CHR has a high prevalence of infection with enteric bacteria, including E. coli O157 (population-based prevalence of 9:100,000), because southern Alberta is a major agricultural area (15, 16). Children have the highest prevalence of E. coli O157:H7 infection in our region (7, 15, 16).

From 15 June to 5 September 2006, stool specimens for culture were collected into a sterile screw-cap container, transported to CLS, and inoculated onto SMAC and CHROM agars within 4 to 6 h after collection. Plates were incubated aerobically for 18 to 24 h at 35°C and read by independent technologists. On average, 10 colorless NSF colonies were picked off the SMAC plate, and all mauve colonies were picked off the CHROM plate. Colonies confirmed with either medium to be E. coli by standard biochemical reactions and positive for O157 by latex particle agglutination (Oxoid) were identified as E. coli O157. Antibiotic susceptibility testing was performed but not routinely reported according to CSLI guidelines (10).

The numbers of colony picks, indole reactions, and O157 serotyping tests for SMAC versus those for CHROM plates were recorded. Economic comparisons for each medium included labor costs based on the current salary scale for medical laboratory technologists (MLTs), and material costs (for media and regents) included applicable taxes. Data were entered into Microsoft Office Excel 2003 (Microsoft Corporation, Seattle, WA) and analyzed using standard statistical methods.

Results for 27/3,116 (0.9%) stool cultures from 27 patients were positive for E. coli O157. All strains of E. coli O157 grew abundantly and were easily distinguished on CHROM as typ-

TABLE 1. Performance of CHROM compared to that of SMAC media

<table>
<thead>
<tr>
<th>CHROM result</th>
<th>SMAC result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>26</td>
</tr>
<tr>
<td>Negative</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
</tr>
</tbody>
</table>

* Corresponding author. Mailing address: Division of Microbiology, Calgary Laboratory Services, 9-3535 Research Rd. N.W., Calgary, Alberta T2N 4B8, Canada. Phone: (403) 770-3281. Fax: (403) 770-3347. E-mail: Deirdre.church@cls.ab.ca.

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ical mauve colonies. Table 1 shows the performance data for CHROM versus those for SMAC. CHROM missed one E. coli O157 infection, but four were missed by SMAC. CHROM missed a repeat culture detected by SMAC from a previously positive patient on both media. No false-positive cultures occurred on either medium. CHROM had a higher sensitivity (96.30%) and negative predictive value (100%) than SMAC but a specificity (100%) and positive predictive value (100%) similar to those for SMAC.

Nine hundred stool cultures required further analysis. The diagnostic efficiency of CHROM was much better than that of SMAC, with a 75% decrease in the number of colony picks (i.e., less false-positive growth on CHROM and better differentiation of O157 due to the mauve indicator), a 52% decrease in indole reactions, and a 43% decrease in O157 serotyping tests. Totals of 771 non-sorbitol-fermenting versus 196 mauve colony picks, 358 versus 185 indole reactions, and 273 versus 156 O157 serotyping tests were done from SMAC versus CHROM, respectively. Overall, the false-positive rate for colony picks for SMAC (65%) was substantially higher than that for CHROM (20%).

Table 2 lists the component costs of performing stool cultures for E. coli O157 detection using either medium. Labor costs for CHROM decreased by 21% (equivalent to saving 0.2 full-time equivalents [FTE]) during the study, while material costs decreased 64% because fewer biochemical tests were done (i.e., indole reactions and serotyping tests), even though the costs for SMAC versus CHROM were higher. Overall, the false-positive rate for colony picks for SMAC (65%) was substantially higher than that for CHROM (20%).

Table 2. Comparison of CLS study costs for using SMAC versus costs for CHROM for stool cultures

<table>
<thead>
<tr>
<th>Medium</th>
<th>Cost of medium (cost per plate)</th>
<th>Cost of other materials</th>
<th>Total MLTb time (FTE)</th>
<th>No. of tests during study</th>
<th>Total study costc</th>
<th>Total annual costd</th>
<th>Total annual labor (FTE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMAC</td>
<td>$872.48 ($0.30)</td>
<td>$1,223.25</td>
<td>0.53 (220.8 h)</td>
<td>3,116</td>
<td>$10,744.12</td>
<td>$51,571.78</td>
<td>2.54</td>
</tr>
<tr>
<td>CHROM</td>
<td>$5,297.20 ($1.70)</td>
<td>$445.04</td>
<td>0.32 (70.1 h)</td>
<td>3,116</td>
<td>$8,501.77</td>
<td>$40,807.94</td>
<td>1.54</td>
</tr>
</tbody>
</table>

a The immediate effects of change to CHROM are as follows: cost of medium, $4,424.72 increase; cost of other materials, $778.21 decrease; total MLT time, 0.2-FTE decrease; total study cost, $2,242.35 decrease; total annual cost, $10,763.84 decrease; and total annual labor, 1.0-FTE (≈$65,000) decrease.

b MLTs and laboratory assistants.

c Total costs include the Canadian Goods and Services tax but not shipping and handling.

d Projected annual resource savings extrapolated from the labor/material savings during the study period.

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REFERENCES


