Coagulase and DNase Testing for Staphylococcus aureus

Overview
This technical bulletin describes and compares the two principle tests used to identify Staphylococcus aureus (S. aureus) and predict enterotoxin producing ability.

The coagulase and DNase methods found in the FDA Bacteriological Analytical Manual and in the Canadian Health Protection Branch Compendium of Methods are briefly described below.

Coagulase
The ability to clot plasma is a widely used method to identify pathogenic staphylococci. Rabbit plasma is mixed with a culture of suspected organism; organisms that produce the coagulase enzyme clot the plasma within 6 hours. In addition to S. aureus, Staphylococcus intermedius and Staphylococcus hyicus produce the coagulase enzyme and are thus commonly grouped with coagulase-positive staphylococci.

DNase
Deoxyribonuclease (DNase) is an enzyme that breaks down DNA. Certain species of bacteria have the ability to produce the DNase enzyme – Staphylococcus aureus, Staphylococcus intermedius, Staphylococcus hyicus, Group A Streptococcus, and Serratia marcescens. This activity is demonstrated by culturing organisms on an agar medium containing DNA and a dye, which changes color in the presence of the degraded DNA.

There are a variety of methods that can be performed to identify S. aureus, including tests for enzymes, such as coagulase, thermos-stable deoxyribonuclease (TNase) and deoxyribonuclease (DNase). Studies have shown that coagulase and TNase activities correlate with S. aureus isolates approximately 99-100% of the time\(^1,2\) and that 96% of TNase-producing S. aureus also produce DNase\(^3\).
Table 1. Percentage of strains that produce coagulase and DNase

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Coagulase</th>
<th>DNase</th>
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<tbody>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>&gt;90%</td>
<td>&gt;90%</td>
</tr>
<tr>
<td><em>Staphylococcus intermedius</em></td>
<td>&gt;90%</td>
<td>&gt;90%</td>
</tr>
<tr>
<td><em>Staphylococcus hyicus</em></td>
<td>&gt;90%</td>
<td>24-56%</td>
</tr>
<tr>
<td>Other <em>Staphylococcus</em> species</td>
<td>&lt;10%</td>
<td>&lt;10%</td>
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</tbody>
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The goal of food safety and regulatory testing is to assay for the presence of those staphylococci capable of producing enterotoxin. While *S. aureus* is the most noted species to produce enterotoxin and cause foodborne illness, *Staphylococcus intermedius* and *Staphylococcus hyicus* have also been shown to produce enterotoxins. Notably, enterotoxigenic *Staphylococcus intermedius* was cited to be the cause of a food intoxication outbreak in October 1991.

The 3M™ Petrifilm™ Staph Express Count Plate contains inhibitors that prevent most DNase producing non-staphylococci from growing on the plate. If colony colors other than deep red-violet appear on the 3M Petrifilm Staph Express Count Plate, the 3M™ Petrifilm™ Staph Express Disk helps to identify *S. aureus* but also may indicate *Staphylococcus hyicus* or *Staphylococcus intermedius* by using a DNase reaction.

Notes and References: