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Comparison of Four Rapid Pathogen Detection Platforms and the Impact on Technician Labor Time and Time to Result

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Introduction

With the introduction of rapid microbiology methods to food testing laboratories, the amount of time to result has been drastically reduced from the traditional cultural methods. The cultural methods involve sample preparation, enrichment time (often primary and secondary enrichments), followed by agar plate incubation time and finally additional steps required to identify the organism. For each of these steps in the cultural methods, a trained technician is employed to execute each step and ensure the method moves forward in an accurate and timely manner ultimately requiring a significant amount of hands on time.

Ideally, staff can manage systems and processes that ensure that testing is performed as efficiently as possible in order to provide their customers with the shortest possible turnaround time. While rapid methods help with efficiency, many tests still require trained technicians to perform a variety of steps, keeping them at the bench rather than deploying them for more analytical tasks.

Turnaround time is a significant factor when food producers are choosing testing laboratories. Turnaround time is a critical component in how a laboratory measures up to other laboratories and whether or not the laboratory can even be considered based on their products.[1] Additionally, if their products are perishable or in high demand, producers want to know that the testing lab they select can provide them with accurate and timely results before releasing product into the marketplace.[2]

Rapid pathogen detection methods can be differentiated by amount of hands-on technician time required. Within each method, there are procedural steps to be performed accurately before ultimately inserting the sample into an automated instrument. Depending on the number or complexity of each of these steps, the time to result and technician bench time needed to perform the rapid method can vary greatly.

This data has been updated to reflect shortened instrument run time for the BioRad's iQ Check Salmonella II method, using Application Protocol File (APF) Fast instead of the classical iQ Check APF.

Objective

The goal of this study was to measure and record the technician labor time and time to result required to conduct the detection of *Salmonella* in ground chicken using four rapid microbiology methods, including the 3M™ Molecular Detection Assay 2 – *Salmonella*.

Methods

Pathogen detection platforms. There were four pathogen detection platforms evaluated in this study:

- 3M™ Molecular Detection Assay 2 – *Salmonella*
- DuPont™ BAX® *Salmonella* 2 PCR Assay
- Bio-Rad iQ-Check® *Salmonella* II PCR Kit (APF Fast protocol)
- bioMérieux VIDAS® UP *Salmonella* (SPT)

Sample group. For each of the four pathogen detection platforms, a total of 96 samples were evaluated in duplicate, resulting in 192 tests per platform for a total of 768 results.

Sample preparation. A total of 96 samples of 25g of ground poultry meat were each placed in a filtered bag and filled with 225mL of filtered water to mimic a sample enrichment step. This was the starting material for each of the four detection platforms (Figure 1). The same sample bag was utilized for all four detection platforms and was closed in between the different platforms to accurately evaluate the full labor time for each of the detection platforms.

Sample preparation — labor time evaluation. During sample preparation, the time needed to prepare 96 samples for enrichment was recorded. This included weighing the sample, placing it in a filtered bag, adding 225mL of water and closing the bag. This is defined throughout as Part 1.

Detection platform — labor time evaluation. Technicians were proficient in using the different pathogen detection systems. One technician was dedicated to only one detection platform. A total of 96 samples were processed and analyzed in duplicate within one workday, resulting in 192 tests. The technician's labor time was monitored and recorded for each step while conducting each of the four *Salmonella* detection platforms following manufacturer's instructions. This is defined throughout as Parts 2, 3 and 4.

Time was recorded during the following parts of the detection protocol (Figure 1):

- Part 1. Sample preparation
- Part 2. Instrument and software setup
- Part 3. Sample lysis/capture
- Part 4. Assay setup

All times when technicians were physically active and engaged with the tests were recorded. Incubation periods specified for each test were considered in the time to result. Since the same steps needed for sample preparation and enrichment were similar for all detection platforms, time measurement in Part 1 (see above) was only recorded for one set of 96 samples. Additionally, since the VIDAS SPT only allows for the analysis of 30 samples in each run of the instrument, run time was considered for 30 samples at a time until the total 96 samples were completed.

Results

Results for Part 1, sample preparation, were the same for all four rapid pathogen detection methods, requiring approximately 116 minutes to complete 96 samples.

The full pathogen detection method technician labor time results (Parts 2–4 in Figure 1) are shown in Table 1 and Figure 2. The 3M™ Molecular Detection Assay 2 – *Salmonella* demonstrated the lowest technician labor time for all steps monitored with a result of 31.7 minutes as compared to the BAX® System (37.3 minutes), the iQ-Check® (63.9 minutes) and the VIDAS® SPT (84.8 minutes). The 3M™ Molecular Detection Assay 2 – *Salmonella* reduced the technician labor time approximately 15% compared to the BAX® System, 50% compared to iQ-Check® and 63% compared to the VIDAS® SPT.

The 3M™ Molecular Detection Assay 2 – *Salmonella* provided the lowest time to result (111.7 minutes) as compared to the other systems evaluated in this study considering technician labor time, sample incubation steps and instrument run time for 96 samples (Table 2). The BAX® System (277.3 minutes), the iQ-Check® (143.9 minutes) and the VIDAS® SPT (291.8 minutes) were all significantly higher. The 3M™ Molecular Detection Assay 2 – *Salmonella* results were 1.29 times faster than iQ-Check®, 2.5 times faster than BAX® and 2.7 times faster than VIDAS® SPT (Figure 3).

Conclusions

While there are many options for rapid pathogen detection platforms in the food industry, it is important to evaluate each method independently and decide which method best meets your laboratory needs. Laboratories are consistently looking for ways to manage their resources and stay within their budget, and a very cost effective cost-cutting strategy can be to lower the cost required to complete each test. A key component to the cost to complete each test is the amount of time that is required for the technician to perform the test. If technician time can be reduced, the laboratory cost per test can also be reduced.

Based on the time to result data generated in this study, using the 3M™ Molecular Detection Assay 2 – *Salmonella* method to perform 10,000 *Salmonella* tests per year would save a laboratory between 55.7 and 312 labor hours as compared to the other detection platforms. This could result in a potential cost savings up to $6,240 annually (assuming $20/hour technician wage) for analysis of a single target organism. The potential cost savings for adopting and utilizing the 3M™ Molecular Detection Assay 2 platform to analyze additional microorganisms could generate even more cost savings for the laboratory.

The 3M™ Molecular Detection Assay 2 – *Salmonella* offers an improved molecular screening test, with a faster time to result and lower technician labor time than the other commercial rapid pathogen detection platforms evaluated in this study. The 3M™ Molecular Detection System has provided the food industry with a robust, cost effective and easy to use rapid method for pathogen detection.

References

1. Factors to Consider When Choosing a Testing Laboratory, Quality Assurance and Food Testing, February 2012, http://www.qualityassurancemag.com/article/qa0212-testing-laboratory/

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3. 3M™ Molecular Detection Assay 2 – *Salmonella* Product Instructions.

4. DuPont™ BAX® System Standard PCR Assay *Salmonella* 2 Instructions for use.

5. Bio-Rad iQ-Check® *Salmonella* II Kit. User Guide. Test for real-time PCR detection of *Salmonella* spp. in food, animal feed and environmental samples.

6. bioMerieux VIDAS® SPT *Salmonella*. Instructions for use.

Table 1.
Labor technician time required to perform pathogen detection in 96 samples.

	Technician labor time (minutes)[a]			
Method Steps	**3M™ MDA2**	**BAX®**	**iQ-Check®**	**VIDAS® UP (SPT)**
Instrument and software setup	1.7 ± 0.3	2.9 ± 0.5	2.9 ± 0.4	5.7 ± 0.9
Lysis/capture	26.4 ± 0.5	28.4 ± 3.6	45.6 ± 0.9	45.9 ± 0.9
Assay setup	3.5 ± 0.5	5.9 ± 0.2	15.3 ± 1.4	33.1 ± 8.2

[a]Results represent the mean and standard deviation of n = 2 technicians.

Table 2.
Time to result for the detection of Salmonella **by four different platforms in 96 samples.**

	Time to result (minutes)[a]			
Method Steps	**3M™ MDA2**	**BAX®**	**iQ-Check®**	**VIDAS® UP (SPT)**
Detection method setup	31.7	37.3	63.9	84.8
Lysis/capture incubation + Instrument run time	80	240	80	207
TOTAL	**111.7**	**277.3**	**143.9**	**291.8**

[a]Preparation of sample including weighing 25g of sample and adding 225mL of culture media was similar for all four methods, at approx. 116 minutes.

Figure 1.
Processing and analysis of ground poultry meat to monitor labor time during pathogen detection.

Part 1.

(1) Collect 25g of ground poultry meat in a filtered bag

(2) Add 225mL of water

(3) Homogenize and close bag

Part 2.

(4) Instrument and software setup

Part 3.

(5) Sample lysis/capture

Part 4.

(6) Assay setup

3M™ MDA2 | **BAX®** | **iQ-Check®** | **VIDAS® SPT**

Follow manufacturer's instruction for pathogen detection platform while technician's labor time is monitored and registered by specific step.

Figure 2. **Total technician labor time involved in performing pathogen testing with commercial pathogen detection methods during the analysis of 96 samples, Parts 2–4.**

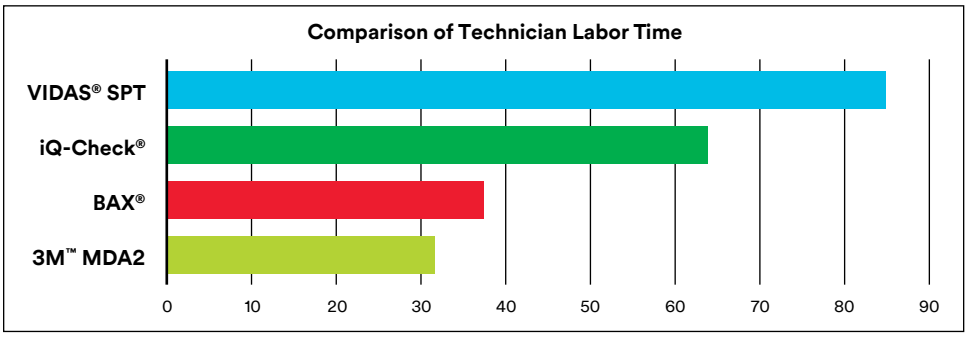

Figure 3. **Time to result required for the detection of** Salmonella**. The values include the labor technician time (first segment) and sample lysis/incubation and instrument running time (second segment). An additional 116 minutes was required for all methods for sample preparation (not shown).**