Is Automated Media Preparation a Good Fit for Your Lab?

Automating media preparation for pathogen testing can improve operational efficiencies for certain food laboratories

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As readers of Food Quality & Safety know, there has been an ever-increasing interest in recent years regarding testing for common food pathogens such as *E. coli*, *Listeria*, and *Salmonella* in commercial foods. Publicity around food disease outbreaks has increased in the media, which in turn has sparked more attention on food safety issues. As a result, more testing is required for food pathogens.

Traditional Pathogen Testing

Testing for pathogens in a food testing lab is a multi-step process and preparing the enrichment media constitutes much of the activity. Figure 1 on page 39 illustrates the typical process flow in the test cycle. After a food sample is received for testing, it is documented for recordkeeping purposes and weighed. Prior to use, enrichment media is prepared and autoclaved for sterilization purposes, and must pass QC checks, which can take several days. The test sample is added to the QC approved enrichment media, and incubated for a period of time, depending on the test method. Finally, the test sample is analyzed, and the test results are recorded and released to the customer. The test method used determines how the sample is analyzed. For example, testing for common food pathogens is typically not a quantitative (or numeric) test, but rather a simple qualitative (i.e., pass/fail) test.

Testing for food pathogens using this traditional method is highly manual and time-consuming, and fraught with problems in the testing process. First, there are numerous opportunities for human error that can affect test results. For instance, incorrect data may be recorded about the test sample, both pre- and post-test. There may also be inconsistencies in the volumes of media prepared for testing, which can have an impact on test results. Evaporation during the sterilization (autoclave) step is a very common problem and can cause measurement uncertainties in the test results. Next, there are a number of safety concerns in the testing process, particularly around enrichment media preparation as it is traditionally done. Autoclaves are used repeatedly, both to heat the enrichment media and to sterilize test containers, leaving various opportunities for contact burns from the autoclave itself or from glassware/containers. Large volumes of heated enrichment media, and the transport of same, also brings the potential for burns caused by contact with hot fluids. Finally, the post-enrichment incubation times may be long due to the time required to bring samples up to test temperature. With many standard testing methods, the enrichment media needs to be at the target test temperature, and using standard media preparation practices, each media container of approximately 3375 milliliter (mL) will need to be pre-warmed prior to use. These media containers are typically placed in an incubator or other heating source in order to do this. Heating large volumes of enrichment media takes time and failing to have the enrichment media at the proper test temperature will obviously influence the test results.

Heateflex's Demeter is an example of an automated media preparator.

HEATEFLEX

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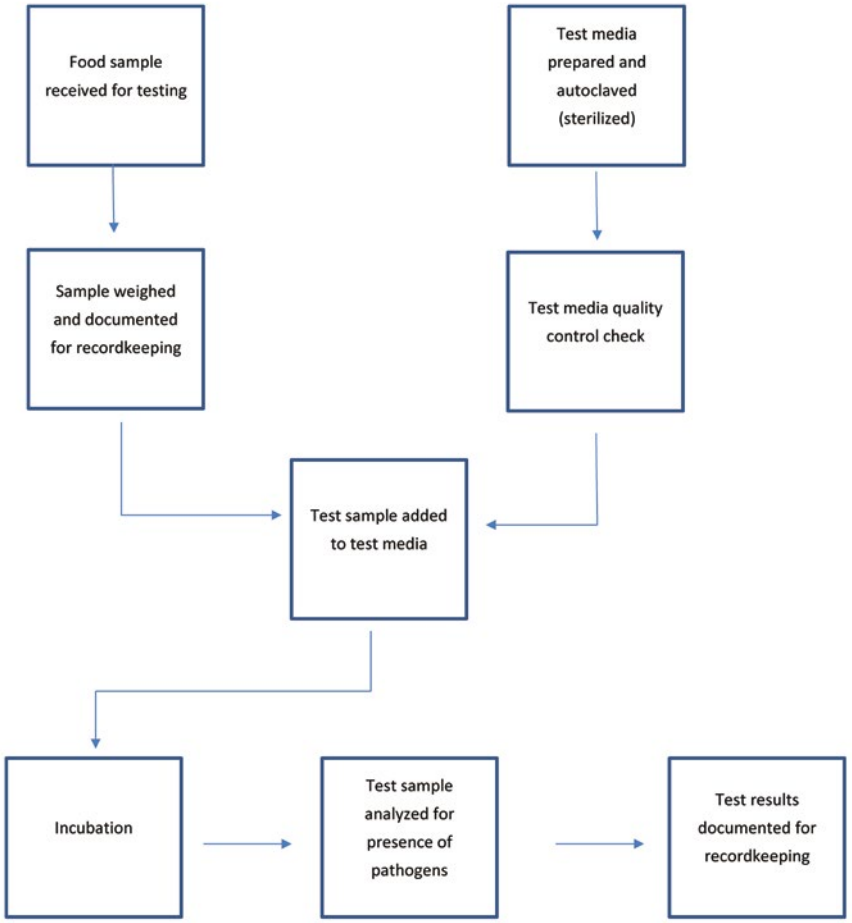
Increasing Efficiency of Media Preparation

Automating the media preparation process in foods pathogen testing can alleviate many of the problems previously described. Most notably, the throughput of test volume may be dramatically increased if QC-approved concentrated sterile enrichment media is added to test containers holding pre-heated and sterilized water prepared by an automated media preparator, which brings the enrichment media up to the final test volume. Tables 1 and 2 on page 40 show an example of how the use of concentrated enrichment media in this manner can allow for up to an 85 percent reduction in the amount of enrichment media that would need to be autoclaved, allowing for far greater throughputs. Dramatically decreased labor and energy costs result from processes that are more efficient, and which require significantly less autoclave time.

Automated media preparators may be valuable in both large and small food testing labs. In using a media preparator for a large lab, with an incubator room, the lab manager first determines the approximate daily sample volume and the amount of enrichment media that would be required in total using traditional testing methods. Sterilized water is then pre-dispensed into test containers to which the concentrated enrichment media will later be added. These sterilized water containers are placed into the incubator room to maintain the proper test temperature prior to testing. When using the system in a smaller lab, without an incubator room, the media preparator is adjusted to dispense directly into the test container, just above the target test temperature, and concentrated QC approved enrichment media is added to the sterile heated water containers. This allows the enrichment media and the sample to maintain the proper temperature prior to and during incubation.

Figure 1. Typical food testing lab process flow.



An Example in Cost Savings

Using traditional media preparation methods, a lab receiving 40 test samples per day at 375-gram sample size each would require 3375 mL of heated enrichment media per sample, or 135 liters of enrichment media per day. By using an automated media preparation system, only 20 liters of concentrated media would be required each day, nearly an 85 percent reduction in volume. This concentrated enrichment media is then added to the remaining volume of sterile water—dispensed at predetermined temperature by the media preparator.

The reduction in costs associated with autoclave use to heat enrichment media in this manner is dramatic, as outlined in Table 1 on page 40. In the standard procedure, 14 hours of autoclave time is required each day to heat the 135 liters of enrichment media, at a cost of about $245 in labor (14 hours x $17.50-hour labor cost). Using concentrated media and a media preparator, only four hours of labor would be required each day: two hours to make the 20 liters of concentrated sterilized enrichment media, and two hours to dispense 115 liters of pre-heated and sterilized test water. The daily cost savings would be $175; 10 fewer hours of labor; and 12 fewer loads in the autoclave.

The savings add up. In the example described above, the weekly labor cost savings comes to $1,225, or over $63k a year. Obviously, the larger the volume of media required each day for testing, the greater the cost savings, and the faster the automated media preparator will pay for

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Table 1. Daily Cost Savings: $175, or 10 hours in labor and 12 fewer loads in the autoclave.

	Standard Practice	Hours Required	Cost ($17.50/ hr.)	With Automated Media Preparator	Hours Required	Cost ($17.50/ hr.)
Number of Samples Per Day*	40			40		
Autoclaved media (liters)**	135	14	$245	20	2	$35
Sterilized water w/o autoclaving (liters)				115	2	$35
Total cost			$245			$70

*375 gram sample, 3375 mL of liquid media
**Market Forge Sterilizer Model STM-ED-95-6300

Table 2. Weekly and Yearly Cost Savings.

Weekly Cost Savings			
Standard Practice	945L	98 Hours	$1,715
W/Auto. Media Prep.			
Concentrated Media	140L	14 Hours	$245
Sterilized Water	805L	14 Hours	$245
Cost Savings			$1,225

Yearly Cost Savings			
Standard Practice	49.275L	5110 Hours	$89,425
W/Auto. Media Prep.			
Concentrated Media	7280L	730 Hours	$12,775
Sterilized Water	41995L	730 Hours	$12,775
Cost Savings			$63,875

itself. In addition to the number of hours required to prepare 135 liters of enriched media per day, the autoclaves in themselves are huge limiting factors in terms of production throughput in the testing lab. Smaller autoclaves aren't capable of keeping up with the large volumes of enrichment media that may be required, and large autoclaves can easily cost more than the media preparation system itself and can require additional staff to keep up with the sample volume.

As an example of a media preparatory, the Demeter, manufactured by Heateflex Corp., automatically heats and dispenses sterile water at a pre-determined temperature into a test container, to which sterile concentrated enrichment media and the test sample is then added. The dispense is highly precise and accurate for each test, eliminating human error. Onboard electronics provide traceability for test temperature and volume, and up to 16 pre-programmed test recipes/dispenses are available for various volumes (225 mL to 5,000 mL) and test temperatures (0 to 50 degrees Celsius). A UV light filtration system ensures that the test water is sterilized prior to the dispense. For recordkeeping, the system includes a scanner to record sample and batch data, and a barcode label printer for affixing test information to the sample container.

Don't Forget Other Possible Benefits

Economic arguments aside, there are other reasons for considering the use of an automated media preparation system in the food lab testing process. First, they're easy to use, and sample accuracy is ensured due to the precise dispense capabilities (both volume and temperature) afforded by these types of systems. Lab recordkeeping can also be automated to a certain extent, as the data collected by these products can often be uploaded to a lab information management system if one is available. And finally, lab operational safety can be significantly improved. There are fewer autoclaves involved in the testing process, and both the heating and transport of large volumes of heated enrichment media may be eliminated.

> Dramatically decreased labor and energy costs result from processes that are more efficient, and which require significantly less autoclave time.

In closing, using automated media preparation systems in the food testing process flow may make a great deal of sense in the operation of many food testing laboratories, but these products aren't for everyone. They're not ideally suited for labs where testing for food pathogens is minimal; e.g., in labs that are primarily focused on quantitative testing. And, in smaller labs, the traditional use of autoclaves and sterilizers may be adequate for test volumes, and there may not be a strong economic argument justifying the productivity advantages of these systems. However, in most other situations, automated media preparation systems are worth a look by laboratory managers who are seeking to improve operational efficiencies. ■

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