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Food Quality

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Food Microbiology: How to Become a Quality Control Freak

What good is testing if you don't know that it works?

BY **KARLA I. FJELD, PHD**

Quality control in the food industry has a multitude of meanings. But the basic principal—to ensure sufficient quality—always remains the same.

In today's market, a company's reputation rests on the quality of its products. When describing the Coca-Cola Co. in his book *Economics: Private and Public Choice, 12th Edition*, James Gwartney, PhD, explains, "The value of that brand name is a hostage to quality control. The firm would suffer enormous damage if it failed to maintain the quality of its products." History shows that companies that have issued product recalls not only endure financial crisis but often struggle to regain customer confidence.

The food industry is experiencing an alarming number of major product recalls due to microbial contamination. In recent years, food safety has become a global concern affecting public health, economics, and international trade. As a result, we are now seeing stronger government oversight with the FDA Food Safety Modernization Act (FSMA) signed into law on Jan. 4. Much of the new law is focused on prevention of contamination in the food supply. Food processors of all types will be required to establish, implement, and monitor comprehensive prevention-based food safety systems, as well as maintain plans for corrective actions when necessary. The FSMA also authorizes the FDA to execute risk-based inspections of food processing facilities and, when necessary, to enforce mandatory recalls of all food products.

Meanwhile, controlling foodborne pathogens has become more complex than ever, with the existence of antibiotic-resistant pathogens and potential adaptation or resistance to traditional food preservation barriers such as acidity, thermal processing, cold temperature storage, dry or low-water-activity environments, and chemical additives. Add into the mix the constant introduction of new rapid test methods and specialized equipment for microbial detection, along with continuously evolving regulatory requirements and standards, and a company can quickly become overwhelmed by the task of keeping up with the demands of this ever-changing industry.

Developing and implementing a sound quality-control program is integral to maintaining quality standards and meeting regulatory requirements. When it comes to food safety, being a quality control freak is never a bad thing.

Assurance vs. Control

Quality assurance is the comprehensive program designed to ensure that production and laboratory processes are held to a minimum standard of quality. This

maximizes the probability that the products made by the production process and the results obtained in the laboratory will be correct and of the highest quality.

Quality control of testing is the inclusion of entities of known characteristics with each test run to monitor the quality of the testing process in order to ensure that the results of each test are accurate and reliable. After all, what good is testing if you don't know that it works? Continuous quality control of tests can help to identify problem areas such as degraded media or reagents, malfunctioning equipment, or improper training of technicians.

For example, using microorganisms of known phenotypic properties alongside an unknown sample helps to ensure that a selective medium supports growth of specific species of organisms and not of others. Without this in-process check, there would be no way to distinguish between situations in which there are no microorganisms in a sample and those in which the media in question cannot support growth.

Microbiological testing methods that should be quality control tested include:

Presence/absence testing: Foods are routinely tested to establish the presence or absence of specific pathogens or toxins. In some cases, the microorganism count may be too low to be detected by enumeration methods, or the microorganisms may be injured by food processing methods, preventing growth on a selective media. It is not uncommon for target microorganisms to be present at levels of only one cell per 100 g of food product. In such cases, enrichment techniques may be necessary.

There are two steps to the enrichment process. The first step is the pre-enrichment, which allows for resuscitation of the target microorganism in a non-selective or only slightly selective environment. The second step is the selective enrichment, which uses a more selective environment to suppress growth of non-target microorganisms while promoting the growth of the target microorganism.

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Enumeration testing: Enumeration testing refers to the determination of the total number of viable cell counts present in a sample. There are two basic types of enumeration methods, direct and indirect. The most common direct methods include the aerobic plate count, also known as heterotrophic plate count, total plate count, or standard plate count. These methods provide a direct measure of the microbial count. The most probable number (MPN) technique is a widely used indirect enumeration method. An MPN is estimated from the positive or negative results obtained in one or more decimal dilutions of the sample.

It is important to remember that microbiological analyses and laboratory processes are susceptible to variation. Therefore, it is critical to monitor variation on a regular basis. Commercially manufactured microorganism preparations are commonly used as daily process controls to monitor methods, equipment, techniques, and environmental conditions. Quantitative microorganism preparations are manufactured to deliver a pre-determined value of colony-forming units (CFUs), so labs are able to consistently recover specified levels of target microorganisms. Inability to recover specified levels of target microorganisms indicates that something is wrong with the process, and the problem must be investigated to maintain quality standards.

Automated technologies such as real-time polymerase chain reaction (PCR) and ribotyping instruments are growing in popularity because of the level of speed and accuracy with which they can detect, identify, and/or enumerate foodborne pathogens. Control organisms are needed for validation and verification of these instruments. The quality control strains used for validation and verification should be selected based upon the manufacturer's recommendations.

New batches of media: Testing new batches of culture media that will be used for the isolation of organisms or enrichment of a sample is critical because you must verify the ability of the media to adequately support microbial growth. This process will also reduce the risk of obtaining false-negative results due to the use of defective media. Testing new media will also help in detecting batches of media that may be slightly more inhibitory than normal. Media with selective or differential properties should be tested to ensure the selectivity of the media.

Media testing can be complicated by the fact that a fresh culture may be more likely to grow on a slightly more inhibitory medium than a microorganism contaminant that was somehow weakened by a component of the test sample. This problem can be partially overcome by challenging the medium with a low CFU count. The use of positive and negative control cultures is essential to confirm that the process, media, or reagents in question will be able to detect the target organism. Ready-to-use quantitative microorganism preparations that are designed to deliver a small number of CFUs can be very beneficial.

Disinfectant verification: Production environments, including food contact surfaces and air, are well-known sources of contamination and should be closely monitored for minimize the risk of post-processing contamination of products. Environmental monitoring and trending data will provide a good assessment of the microorganism strains that are found most often in your facility. This information, along with a disinfectant qualification study, will help to make clear which chemical agents are best for removing environmental microorganisms.

Disinfectant effectiveness should be verified for each potential disinfectant before being put to use. Challenge micro- organisms for disinfectant qualification should include both reference cultures and environmental isolates. Disinfectant qualification is commonly done by inoculating surfaces with a sample that simulates the contamination that would occur during work sessions. After the disinfectant has been used on the

inoculated surface, contact plate testing is done to determine whether or not the disinfection was effective.

Proficiency: Quality of test results is dependent on the quality of

the people performing the test. Proficiency testing is an integral part of laboratory activities. The ISO/IEC 17025 standard requires proficiency testing activities for all tests listed in the establishment's scope of accreditation. The purpose of this testing is to ensure that each accredited laboratory is capable of conducting tests and producing data in an accurate and repeatable manner. Laboratory competence can be demonstrated to customers, potential customers, and accrediting bodies through the presentation of proficiency testing data. A regular proficiency testing schedule helps to identify problem areas before they affect the quality or safety of products. ■

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Choose a Supplier of Reference Materials

Biological reference materials are used to assure the quality of your test results and should always come from a reputable source. There are several things to consider when choosing a supplier of biological reference materials. First, the supplier's credentials should be evaluated. The certifications and accreditations that a supplier holds will give an indication of the company's quality system and provide third-party verification of the supplier's competence and compliance with global standards.

Traceability is another area that should be taken into consideration when selecting a reference material supplier, especially in the case of reference cultures, because repeated preservation, processing, and subculturing could lead to mutation or characterization aberrations.
A supplier should provide documentation or evidence that a reference culture is traceable to its original source.

Other factors to take into account are the time, labor, and cost savings offered by the supplier. Commercial reference cultures are available in a variety of different formats. Make sure your supplier offers products that meet your specific needs. Think about the types of testing being performed and the frequency with which they are used. With your list of challenge microorganisms in mind, decide if a qualitative or quantitative microorganism preparation would be beneficial. Compare the ease of use and preparation time for all available options. Customer service and after-sale technical support should also be considered. ■

Other Resources

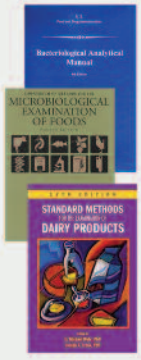
There are many organizations and other resources available to help you develop and implement a reliable quality-control program, including:

Association of Official Analytical Communities, www.aoac.org

Food and Drug Administration, www.fda.gov

Department of Agriculture, www.usda.gov

United States Pharmacopeia, www.usp.org



Bacteriological Analytical Manual, published by the FDA, www.fda.gov

Compendium of Methods for the Microbiological Examination of Foods, published by the American Public Health Association, www.apha.org

Standard Methods for the Examination of Dairy Products, published by the American Public Health Association, www.apha.org

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