Modern food safety practices for poultry processors

Food processors, consumers and regulators around the world have placed an increased emphasis on foodborne illnesses and how steps can be taken at every point along the food chain to help prevent outbreaks. There are two significant pathogens that continue to pose significant challenges for the poultry industry – salmonella and campylobacter.

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These pathogens are garnering increasing attention from food safety and quality assurance managers for dual reasons: their prevalence and their complexity.

Challenges in detection

According to the US Centers for Disease Control and Prevention (CDC), 1.4 million cases of foodborne illness and more than 450 deaths are annually attributed to salmonella infections in the United States alone.

Campylobacteriosis is the second most frequently reported cause of foodborne illness, accounting for 1.3 million reported illnesses in the United States every year. The sheer volume of cases caused by these dangerous pathogens has increased the pressure on producers to ensure that their foods are as protected as possible.

Raw poultry products are contaminated with salmonella and campylobacter throughout the entire supply chain – not only in processing facilities or on the farm but during slaughter operations.

Consequently, proper sanitary operations and the use of antimicrobial interventions are necessary to minimise contamination occurring during slaughter and when the carcases are fabricated into parts and comminuted (for example, ground or mechanically separated non-ready to eat) products.

While the majority of foodborne illnesses occur from ingesting these pathogens from improperly handled or cooked poultry, an outbreak can still cause significant damage to a brand's reputation.

However, just because salmonella and campylobacter can seem ubiquitous does not necessarily mean they are easily found. To the contrary, these organisms pose particular challenges when it comes to the ease in which the contamination can be detected and reduced.

Testing for salmonella and campylobacter in poultry can be especially challenging due to the complex nature of the matrices. Detection of these pathogens is often assessed at the primary production level, in broiler carcase and/or bird parts rinses and in raw meat.

Competitive microflora in all of these types of samples can impact the growth of salmonella required for detection in most culture-based methods.

In addition, confirmation procedures become complex when associated microflora are also recovered in most salmonella and campylobacter selective agars. Therefore, traditional agar methods are not optimal to rapidly and accurately assess the presence of salmonella and campylobacter in poultry products.

Regulators around the world are increasing their requirements to try to address these challenges.

Increased regulations

The US Department of Agriculture's Food Safety and Inspection Service (USDA FSIS) established its salmonella verification program and performance standards in 1996 as part of the Pathogen Reduction Program to verify process control in meat and poultry slaughter and processing establishments.

The performance standards were established from national baseline studies conducted prior to the rule's creation, and, currently, apply only to livestock carcases.

Continuing to advance the monitoring program, USDA FSIS implemented a revised salmonella and campylobacter testing program in 2016.

Table. 1. USDA FSIS performance standards for salmonella and campylobacter in poultry.

Product	Maximum acceptable % positive		Performance standard*		Minimum number of samples to assess process control	
	Salmonella	Campylobacter	Salmonella	Campylobacter	Salmonella	Campylobacter
Broiler carcase[1]	9.8	15.7	5/51	8/51	11	10
Turkey carcase[1]	7.1	5.4	4 /56	3/56	14	19
Comminuted chicken (325g sample)[2]	25.0	1.9	13/52	1/52	10	52
Comminuted turkey (325g sample)[2]	13.5	1.9	7/52	1/52	10	52
Chicken parts (4lb sample)[3]	15.4	7.7	8/52	4/52	10	13

[1] The maximum acceptable percent positive for salmonella and campylobacter under the performance standards for young chicken and turkey carcases (FRN Docket No. FSIS 2004-0023; 2015),
[2,3] New performance standards (FRN Docket No. FSIS 2004-0023, 2016),
* Number of samples allowed to be positive out of a total number of samples analysed.

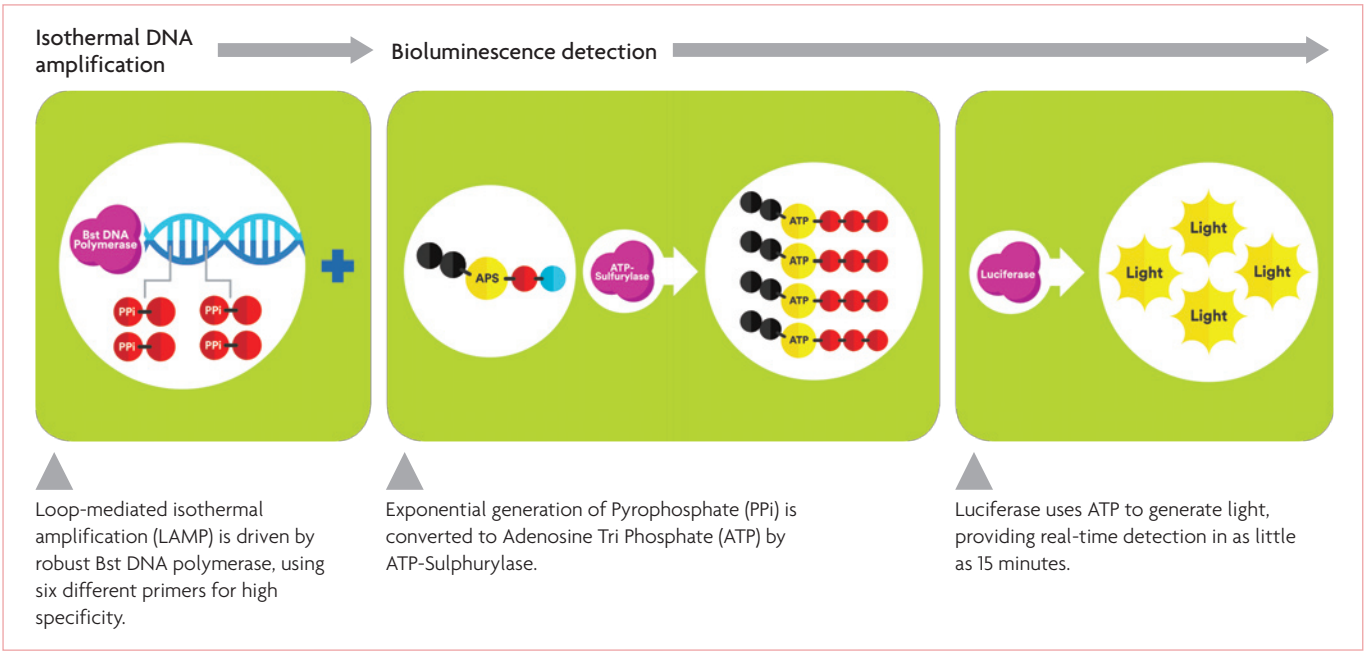

Fig. 1. LAMP-Bioluminescent technology.

In 2016, USDA FSIS also replaced its salmonella specific sampling set-approach with a routine sampling approach for all USDA FSIS-regulated products that are subject to salmonella and campylobacter verification testing.

This includes broiler and turkey carcases, chicken parts and non-ready to eat (NRTE) comminuted poultry.

Salmonella and campylobacter performance standard verification samples are now taken as part of a 'moving window' sampling approach, and the results are used to determine if an establishment is meeting the performance standard on a continuous basis. USDA estimates that the new standards will prevent about 50,000 illnesses each year.

New limits created

This program has created new limits on the number of product samples that test positive for a pathogen (Table 1). For example, the new salmonella standards require contamination rates of no more than 25% in ground chicken, 19.6% less than the former standard.

USDA FSIS ultimately aims to achieve a reduction of illnesses from chicken parts and ground poultry of 30% for salmonella and 19-37% for campylobacter. It will assess establishments' performances based on maximum acceptable percent positive rates, and will categorise processing plants into category 1, 2, 3, passing or failing.

The US is certainly not alone in these efforts. Government agencies around the world are taking similar steps as the USDA FSIS to reduce contamination in poultry.

This has resulted in the need for easier, more effective pathogen testing, especially for salmonella and campylobacter in poultry production. In addition to increased laws and regulations, significant food safety progress is coming by way of advanced science and technology.

New innovations

Through the early 2000s, DNA-based methods commonly utilised polymerase chain reaction (PCR) for a wide range of applications including detection of pathogens in food and food processing environmental samples. PCR methods typically require multiple steps to process enriched food samples and amplify target DNA for detection of pathogens.

The 3M Molecular Detection System, first launched in 2012, remains a breakthrough for increasing the speed and accuracy for pathogen detection with unparalleled ease-of-use.

The 3M Molecular Detection System took advantage of advances in biotechnology to surpass other molecular-driven methods for amplifying target DNA, improving accuracy and minimising time and technician steps. It is based on an innovative combination of technologies – loop mediated isothermal amplification (LAMP) of DNA and bioluminescence detection (Fig. 1).

The incorporation of LAMP technology allows for a simpler sample preparation process with only two transfer steps instead of the more complex DNA extraction and purification steps used in PCR.

The reduction of steps allows laboratories to process more samples in less time, allowing for a reduction in cost, time, energy and manpower.

For example, a study commissioned by 3M showed that using the 3M Molecular Detection Assay 2 – Salmonella to perform 10,000 salmonella tests would provide results up to 2.6 times faster than the other methods, saving a laboratory between 132 and 312 labour hours annually and resulting in substantial annual cost savings.

Considering that this is just one target micro-organism, the potential cost savings for utilising the LAMP technologies like 3M's platform for additional micro-organisms like campylobacter could generate even greater efficiency.

As a result, the USDA Food Safety and Inspection Service recently decided to make the 3M Molecular Detection System their primary detection method for salmonella and listeria in 2018.

Placing safety at the forefront

The entire food industry is undergoing major changes to meet the highest safety standards, and poultry producers are a part of this movement.

The USDA along with other agencies around the world are working to establish new standards and policies driving food manufacturers, packagers and service providers to ensure that safety is placed at the forefront.

The best course of action is to adopt a total solution from sample collection and preparation to monitoring and detection.

Whether it is salmonella and campylobacter in all of their pervasiveness and complexity, or another pathogen altogether, the goal should be to mitigate risk at every step while improving operational efficiencies and productivity. ■

References are available from the author on request