Quantification versus prevalence – diagnostic tools for pathogen testing

Food safety is always a concern for every food processing facility. However, by following HACCP guidelines and testing regulations at each step of the process, final product is generally released with no traces of contamination. This is because most processing plants have implemented strict procedures for testing for the presence of bacterial pathogens such as salmonella or ifE. coli. These results do not tell the whole story though – they do not reveal the pathogen load (quantity).

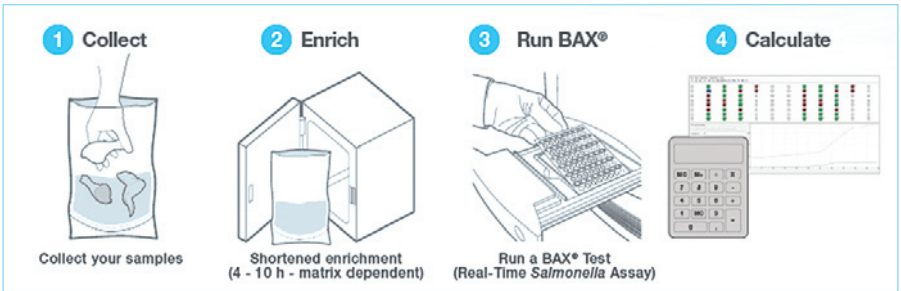

Fig. 1. Four steps to quantify salmonella.

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Presence (or prevalence) of pathogens is a yes or no answer; results indicate either the presence or absence of the organism. Of course, prevalence is then calculated from all tests at each stage in the manufacturing process to calculate a percentage of samples tested. For example, a plant might take samples from multiple areas for testing. When they test 100 carcases and 10 are positive, then the prevalence is 10% for contamination of the carcases.

Other areas will have different prevalence values, especially as product is further processed. This prevalence data helps the plant manager with process control – expecting to see a decrease in prevalence as the product moves through each step of processing. If a spike is seen in one area, this may indicate a problem within the facility or its equipment at that specific spot.

Nevertheless, prevalence results do not tell you how many organisms were present in any of the positive samples – it could have been a low count of a few cells or a high count of many cells per positive sample. This is because the testing process includes enrichment step(s) which allows the bacteria to multiply to a detectable level, so the result is generally not quantifiable.

However, it would benefit any food processor to also understand the level of pathogen contamination, as higher levels would mean a higher food safety risk. The question is whether quantification should be done along with prevalence and whether it needs to be conducted at all processing steps. There are many benefits of conducting both prevalence and quantitative (load) testing. It allows plant managers to fully understand what is happening in the facility at every step of processing. For example, if prevalence is low, but organism numbers are high in those positive samples, it could mean equipment is allowing for cross-contamination of those few positive samples or if at an early step in the process, the animal may have entered the facility with a high microbial load.

Find the source of contamination

No matter the results, the data collected allows the plant manager to pinpoint the source of the contamination and improve methods to reduce it moving forward. On the opposite end of the spectrum, a high prevalence rate but low pathogen numbers may mean process control may be failing or more antimicrobial cleaning is needed to reduce load even further.

Either way, by quantifying organism numbers, the plant can determine if interventions are working to reduce pathogen load overall and even reduce prevalence.

Measuring and understanding both prevalence and pathogen load is one way to improve performance standards in any food processing plant. It also allows for open communications between the animal providers and the processors, leading to a safer, more reliable food supply for all of us. This is especially important in the meat and poultry industries where live animals enter the facility, introducing contamination, and end products cannot be commercially sterilised, so the risk of pathogen presence is much higher.

When it comes to key pathogens of concern such as salmonella, the lower the incoming pathogen load, the better the chances that antimicrobials will reduce the pathogen. By performing both prevalence and load (enumeration) testing, this can be determined, allowing data-based decisions to be made for overall improvements in pathogen removal.

When it comes to testing for salmonella in poultry, beef or pork, testing can be done for both prevalence (limits) and quantitation (load) using the BAX System. The BAX System Real-Time PCR Assay for salmonella has been shown to be equivalent to the reference methods for salmonella detection and in addition, has been validated for quantification of salmonella in ground turkey, ground chicken, poultry carcase rinsates and caeca, ground beef and beef trim, and ground pork and pork trim.

The PCR system for salmonella can detect thresholds of 10 cfu/g (LOD10) for all product types and for PCR quantification, known as SalQuant, the lower limit of enumeration was 1 cfu/g (LOD1) for most sample types with an incubation of anywhere from 3-12 hours at 42°C, depending on the type of product.

This method allows plant managers to accurately detect contamination levels in meat and poultry products rapidly, simply and effectively. By quantifying results instead of just detecting prevalence, not only will processors know if a product lot is positive for salmonella, but they can also determine how much salmonella is present to make critical decisions about further processing of product for sale. ■