Reflections on laboratories and laboratory testing

Laboratory testing is now a part of everyday life in modern meat production, but have you ever stopped to think 'what is laboratory testing?' If you have, secondary questions come to mind and it is these that this article will address in general terms.

Laboratory testing can be undertaken in house or contracted out to an external contract laboratory. The arguments around in house testing relate to possible cost savings and speed of results, whereas those with regards to external testing relate to independence of results and more experience with little used tests.

A realistic approach for a large meat processor/producer is to test samples in house for routine testing, for example, NIR testing of incoming ingredients or testing for key microbiological parameters, such as faecal indicators, and to put the more specialised, less frequent work out to appropriate contract laboratories. This also addresses the issue of having to spread high test accreditation costs over relatively few samples/tests.

Also, some customers may require special accreditation, for example, their own accreditation scheme, that warrants external placement of such work rather than incurring the costs of gaining that status for the in house laboratory, assuming that customer allows the use of an in house laboratory.

With laboratories, first impressions can tell you a lot.

Testing programmes

So, how do we go about deciding on our testing programme? From now on we will only consider microbiological testing. Firstly, we need to ascertain what testing has to be undertaken to meet statutory or contractual requirements. Sometimes, for example for exports, the actual laboratory or category of laboratory to be used will be specified.

Then we need to determine what level of testing would be regarded as 'good practice'. This will involve a risk assessment with high risk products likely to require more testing.

For the purpose of this exercise a high risk product is one that intrinsically carries greater food safety risks or one that will be going to a high risk consumer group, such as babies, the very old, pregnant women or the immunocompromised.

Unfortunately, there is no one reference source that can be used in this exercise for benchmarking purposes, although some of the EU documents go part way to satisfy this need. A good starting point is EU Document 2073/2005 on Microbiological Criteria for Foods and its subsequent amendments as this document also considers limits.

Quite soon we will start to have a list of products, ingredients, swabs etc that will require regular testing and the tests each will require. In addition, we will have categorised the products into high, medium and low risk products. High risk products require testing more frequently. Are there any seasonal products?

Then we can start to put a cost to the tests required. To do this we can use a spread sheet to plan out our ideal testing programme. In the extreme, this is every product every hour! But in practice it is probably every product every day or shift.

If we cost our 'ideal scenario' it will very likely take us way, way over our budget! We can address this by starting with our annual budget figure. Divide this by 13 and allocate 1/13th to each calendar month and keep the 13th as your contingency budget.

We then need to undertake 'what if scenarios'. For example, what are our costs if we test high risk products daily, medium risk weekly and low risk monthly. We keep doing this until our costs of testing are equal to or less than our budgeted spend.

We then look at the testing programme this gives us and see if it satisfies all the stakeholders such as governments, EHOs, and customers. If it does we have our testing programme; if not we need to negotiate and compromise . . . or go to our company accountant with a case for an increased testing budget!

We then need to match this up with laboratory capacity. We may have 120 products which need to be tested quarterly. Rather than submit all 120 samples on the first day of each quarter it is much better to test 10 products a week on a rolling basis.

The remaining four weeks can be taken up by the Christmas/New Year shutdown and the two week summer holiday break when the factory is closed. This has two advantages – the laboratory workload is more evenly distributed and we are getting some results every week, therefore 'keeping an eye on the shop'.

So, at the end of the day, we can summarise our annual testing programme on a spread sheet and use this to calculate our

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week by week costs. The last 13th of our budget is our contingency fund for retests, new tests etc. Most companies have a separate budget for shelf-life and new products testing.

Hand in hand with this comes the issue of standards. In defining microbiological standards we need to give due cognisance to the standards recommended by governments and customers as well as documents such as EC 2073/2005 (see above). An alternative approach is to set individual standards at a level which, had it been applied last year, would have failed 5.0 or 2.5% of products. Then by comparing this year's fail rate with last year's we can see if we have an improving or deteriorating situation. This can become a dynamic system that is annually reviewed.

In fact, there is merit in having two standards – one for internal consumption, for example the customer's standards, and the other based on a 5.0% fail rate which is strictly for internal use. This latter system then acts as an early warning system.

Philosophy on standards

We then need to decide our philosophy on the use of standards. Are we going to make them as high as possible so we 'pass' as many products as possible or are we going to set them low and use this as an early warning?

Taking this point a bit further we need to consider what we are actually going to do with the results? Unfortunately, there are still QA/QC managers about who take a quick glance at the results and then file them for posterity!

Good managers do three things with results. Firstly, they identify out of specification results and then investigate why such a result was obtained. If something needs rectifying then action is taken. Finally, they retest to confirm this.

However, it should be recognised that 'rogue results' do occasionally occur and that 'one swallow does not make a summer'. How do such results occur?

To start with we must recognise that we are testing a biological entity and variances will occur. For example, one mouse or fly dropping in 100 tonnes of product will only give a high enterobacterial count if we are unfortunate enough to take a sample that contains that dropping. If we go back for further samples and the dropping has been removed with the first sample, we will then obtain satisfactory results.

If we take 100 samples from a batch we will not get 100 identical results but we will get a spread of results that will usually follow a normal distribution.

Secondly, our good manager will analyse the results to see if he can detect any underlying trends – are we holding steady or are results improving or deteriorating?

Here again, we should not over react to

one abnormal result. Smoothing off of the data is to be recommended by using a statistical programme such as CuSum. Graphs can serve a useful purpose here.

Thirdly, a good manager will use results as a motivational tool. Unfortunately, there are many managers who only advise staff of bad results accompanied by a rebuff or scolding! Why not tell them good results and accompany this with appropriate praise! This is especially so with hygiene swabs as a motivated cleaning team invariably lifts its standards!

Another issue which surfaces with external laboratories is how do I choose my laboratory? For starters, they will need to satisfy you that they are suitably accredited. In this context, we need to correct a common misunderstanding and that is that although we talk about an 'accredited laboratory' it is actually the tests that are accredited.

So, we need to check that the laboratory is accredited for the tests that we want to have done! In the early days of laboratory testing some laboratories became accredited for one test and then misled potential customers by saying they were accredited – without saying it was only for one test!

Questions to consider

Once we know we have the correct accreditation in place, we basically choose a laboratory that we feel happy to work with. What are its people like? Does it have a suitable sample collection service? Does it turn results round in a time that is acceptable to us? Are reports in an acceptable style and format? Is advice and support available? Are their prices acceptable? These are all questions that you might want to ask. When it comes to price, it is worth remembering that you get what you pay for!

Another thing worth reflecting on is that laboratories test samples on an 'as received basis', that is, they are testing what they are given and it is the submitting party's responsibility to ensure that the correct samples are taken and correctly identified (labelled).

The submitting party is also responsible for ensuring that the sample is the correct sample and has been correctly (aseptically) collected as well as being correctly handled between being taken and submitted to the laboratory (or its collection van). For microbiological samples, this means storing in a refrigerator or Kool Box. Do not be surprised to get elevated bacterial counts if your swabs or samples were left on a windowsill in the sunshine or on a shelf above a radiator!

On the other hand specific zoonotic pathogens, such as salmonella or Listeria monocytogenes, can not be spontaneously created – they must have come from somewhere. If we get the unexpected detection of such an organism we need to check whether there were any opportunities for contamination of the sample to have occurred after sampling, during transit to the laboratory or during the testing procedures.

Experience shows that false results for zoonotic pathogens often turn out to be correct as subsequent similar samples turn up as positives.

Examples of contamination

Let us take two examples to show how contamination can occur.

The first involved bulk pasteurised liquid egg. The company concerned took various samples and only those taken through the exit valve of a particular storage container yielded Salmonella enteritidis.

On a detailed follow up investigation it was found that the pipe external to the exit valve missed out on the cleaning programme and this contained the S. enteritidis. This was then seeding liquid egg that passed through it with the salmonella.

Some years ago a bakery was finding Listeria monocytogenes in its gateaux. Careful sampling of gateaux revealed that none of the internal components were contaminated with L. monocytogenes – only the outer surface of the cream was.

Thus, contamination was occurring after the gateaux had been made. Careful detective work then found that L. monocytogenes was on the vanes of one of the cooling units in one of the chillers.

In both these instances the initial human reaction had been to point the finger of blame at the supplier but, in both instances, the source of contamination was in the actual production plant.

The final point worthy of reflection is that as tests get more and more sensitive there will be more and more positive results!

This is borne out in many trials which show PCR to be more sensitive than traditional cultural methods. Sooner or later we are going to have to decide when is a positive really a positive that merits action. Do we react to a PCR result that detects genetic material or do we react to the detection of viable zoonotic pathogens capable of causing food poisoning?

This debate could run and run ■