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Bacteriophage use in *Campylobacter* control

We love a good acronym at the Micro Bulletin, and the wonderfully named C-SNIPER project stands for the Campylobacter-Specific Nullification via Innovative Phage-mediated Enteropathogen Reduction programme.

This is a new initiative which is being promoted to help reduce the levels of *Campylobacter* in poultry farms in Europe. *Campylobacter* is still the most commonly reported foodborne illness in Europe and levels have remained stubbornly high despite measures taken by many countries to try and reduce the levels, especially in raw poultry.

We have looked before at the applications of bacteriophages (viruses which will specifically attack specific types of bacteria), and in this instance, a prototype of a phage solution against *Campylobacter* has been developed, and is now set for production at a mini-pilot scale. However to date, there is no regulation in the EU for bacteriophage use in food applications so we may have to wait for regulatory approval before this technique can be widely adopted.

The use of bacteriophages in food has already been approved in several countries around the world for *Listeria, Salmonella*, and *E. coli* but no *Campylobacter* specific phages are as yet commercially available.

The second stage of the project, which continues into 2021, involves scaling up production and in vivo validation trials to confirm the phage-based cocktail designed is significantly effective on poultry meat. The ultimate goal is to commercialise the product in poultry production and processing settings worldwide within the next two years.

Other mitigation strategies such as biosecurity measures, reduction of slaughter age, vaccination, use of pre and probiotics, or other antimicrobials as feed additives have been proposed, and it may be that measures combining all of these strategies may be required and will need to be applied on a concerted European-wide level to successfully further reduce the levels of *Campylobacter* in poultry.

FSA issue notice of shell eggs

The Food Standards Agency last week released precautionary safety and handling advice on several batches of British Lion shell eggs which had been on sale at 6 different major retail outlets. This was because the eggs had all come from the same supplier where it was stated that *Salmonella* had been found in the environment and that there was a risk that the eggshell surface may have become contaminated.

The communique did not state how many positive environmental samples had been detected and if they were from surfaces which would come into contact with the eggs. It would appear that a higher level of detections than usual must have been found as the occasional detection of *Salmonella* must be expected from a non-food contact surface in this type of environment.

Hopefully the FSA will provide more information on the precise nature of the contamination, and the associated risk to the eggs.

Following reductions in the number of outbreaks associated with the consumption of shell eggs in the last 20 years, the FSA stated in 2017 that vulnerable individuals such as infants, children, pregnant women and elderly people could safely eat raw or lightly cooked eggs that were produced under the British Lion Code of Practice.

Recall of Sausages

The FSA also issued a re-call last week for a spicy sliced sausages sold by a major retailer because of contamination with *Listeria monocytogenes.*

The sausages were fermented, cured, smoked which may be eaten without cooking, as the fermentation and curing processes provide enough pH and water activity control to ensure the safety of the product.

The fact that this product contained *Listeria* at levels above the legal limit suggests that there may have been a failure in the fermentation process.

US Yet more *E coli 0157 H7* outbreaks linked to Romaine lettuce

Over the last 3 weeks there have been another 3 reported outbreaks of *0157 H7* associated with the consumption of Romaine Lettuce.

This seems to be an ongoing problem in the States, with numerous outbreaks of *E coli 0157* linked to the consumption of Romaine over the last few years.

The long running financial consequences of food poisoning outbreaks

The legal implications and ramifications of our clients becoming involved in food poisoning outbreaks was illustrated last week when the Supreme Court of Canada issued a ruling on Maple Leaf Foods who were implicated in a *Listeria* outbreak in 2008 caused by contaminated cooked meats processed at the Maple Leaf plant. It has taken 12 years for the Supreme Court to deliver a final ruling on a compensation case brought by a sandwich franchise which sued Maple Leaf for loss of business due to the shortage of raw material in the eight weeks when Maple Leaf shut down their operations. This final court ruling went against the sandwich franchise, but to date the outbreak is estimated to have cost Maple Leaf over 27 million dollars in compensation payments to the victims of the outbreak, and a similar figure (20-30 million) which was associated with the direct recall costs at the time of the outbreak.

From Cowpox to synthetic mRNA – how vaccines have evolved, and what are the implications for food microbiology?

As early as 1774 a Dorset farmer Benjamin Jesty claimed to have successfully vaccinated his wife and children with cowpox and induced immunity to smallpox during an epidemic, but it wasn't until 1796 when Edward Jenner famously experimented on James Phipps, the son of his gardener that the procedure became widely understood.

Jenner, a physician and scientist had noticed that milkmaids were generally immune to smallpox and he postulated that the hand blisters that the milkmaids often received from cowpox (a similar but much milder disease compared to the highly contagious and deadly smallpox) offered some immunity.

In an experiment which would leave today's medical ethics council lost for words, Jenner inoculated the 8 year old with the pus from cowpox blisters from the hands of a local milkmaid. He then tested his theory by inoculating the boy with the smallpox virus and although he had a slight fever, he remained generally well.

The milkmaids name was Sarah Nelmes, and the hide from the cow (predictably called Blossom) from which she caught the cowpox disease, is still on display in the library of St Georges Medical School in London.

Jenner continued his research and published his findings on the cases, including conducting the same experiment on his 11 month old son! The medical establishment deliberated at length over his findings before finally accepting them, and in 1840, the British government provided vaccination to the general public using cowpox free of charge.

Fast forward nearly two centuries and probably the greatest achievement in world health was announced on the 8th May 1980 when the World Health Assembly officially declared that smallpox had been eradicated after a successful worldwide vaccination program. It was estimated that 300 million people had died from smallpox just in the 20th century alone.

Going forward another 40 years, and we are now possibly on the verge of another momentous moment in science.

The two new COVID vaccines developed by both Pfizer and Moderna, which have reported promising initial results in the last couple of weeks both incorporate a totally new way of triggering an immune response. Rather than containing an attenuated or weakened virus (which is sufficient to stimulate the immune system, but not strong enough to cause illness), the new vaccines contain synthetically produced messenger Ribonucleic Acid (mRNA). If the DNA code is the design blueprint, then the RNA is the manufacturing factory which puts all of the components together. The vaccine introduces an mRNA sequence into the body that contains the genetic instructions for the person's own cells to produce the vaccine antigens and generate an effective and specific immune response. The intriguing part is that we actually produce the antigens ourselves and as they are just a fragment, rather than the whole complete virus the "viral particles" are completely harmless.

Many of the techniques we employ in the lab utilise the specific antigen-antibody binding reaction as a key methodology component.

Our *Salmonella* and *Listeria* ELISA methods rely on antibodies which have been raised against defined strains of these organisms to "capture" the target cells in the wells of the microtiter plates and enable subsequent detection of the pathogen. The manufacturers of these diagnostic tests have to try and achieve a compromise between making the antibodies too specific whereby they won't detect the cells of the pathogens which may be "stressed" due to the processes involved in food manufacturing, and making them "not specific enough" whereby we will get many presumptive positive reactions in the wells which then subsequently fail to confirm as the target organism.

It may therefore be possible in the future, for synthetic antibodies to be produced which will specifically bind to a specific antigen or sequence of antigens which we know are totally specific for the target pathogen but which we also know are unaltered and are not modulated by stress factors such as heating, chilling, freezing, and all of the other things we do to organisms which are present in food during the manufacturing process. The identification of specific sequences will be assisted by the growing wealth of pathogen and non-pathogen whole genomic sequences that are now freely available to help identify specific targets in the same way that shared Corona virus sequence data has facilitated the development of the novel synthetic RNA vaccines.

Breakthroughs in one area of science often can have implications in other areas, so hopefully the acceptance of synthetically produced antigens in the field of vaccines may lead to further improvements in our own world of food microbiology pathogen detection.

As we have said many times in the micro bulletins, watch this space…….