Microbial update

campylobacter

Dr Roy Betts, Head of Microbiology, Campden BRI, Chipping Campden, Gloucestershire, GL55 6LD, UK.
Produced as a service to the food industry by Thermo Fisher Scientific.

The history of the understanding of campylobacter as a foodborne pathogen is a fascinating lesson in failing to understand the significance of scientific findings. Butzler (2004) gives an excellent review of the early beginnings of the knowledge of the organism. In 1886 the German bacteriologist Theodor Escherich observed spiral organisms in stool samples from children with diarrhoea (he called it cholera infantum). He published several articles in a German Medical Journal made drawings of small 'vibrios' seen in the intestinal mucous of infants, and even tried, unsuccessfully, to culture the organisms. Incredibly Butzler reports in his paper, that these articles remained virtually unknown until 1985.

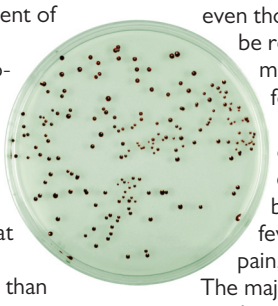
In the veterinary area, campylobacter has been known as a cause of animal illness for many years. In 1909 McFaydean and Stockman isolated such vibrios from foetal tissue of aborted sheep. In 1919, Smith studied infectious abortions of cattle and isolated a spiral shaped bacterium which he rightly associated with the vibrios reported by McFaydean & Stockman. He gave the name of Vibrio fetus to the organisms. Right up until 1962 spiral bacteria were being isolated from farm animals suffering a variety of ailments, and these were called 'Vibrios'.

Meanwhile in humans, these 'vibrios' were beginning to be noted as causes of illness. In 1938, over 300 inmates of two prisons in the USA became ill with what is believed to be a milk borne outbreak. Organisms resembling Vibrio jejuni were grown in broth cultures from blood sample of some of those affected. In 1947 V. fetus was isolated from the blood of pregnant women that had fever. But only in 1963, was Vibrio fetus transferred into a new genus – campylobacter. Following this, many of the species previously classified as Vibrio were moved into this new Genus, including C. jejuni and C. coli.

In 1957, prior to the assignment of the new Genus, King and co-workers successfully isolated 'Vibrios' from the blood of humans with diarrhoea, this being the first ever isolation of these organisms from any source. However, only in 1968 was campylobacter isolated from stool samples of a person suffering severe diarrhoea.

This brief history shows so clearly the reliance of medical and veterinary microbiology on the development of good reliable test methods and without such procedures we may have theories and ideas, but these can never be fully proven.

Since that time, the development of selective growth media in the 1970s permitted more laboratories to test stool specimens for campylobacter and it was soon realised that campylobacter species were common human pathogens. Indeed, in many countries it is acknowledged that campylobacter causes more reported cases of human illness than any other single organism.



What is it?

Campylobacter and arcobacter are in the Family Campylobacteriaceae, they are Gram negative narrow long rod shaped bacteria. They are spiral shaped, do not produce spores and have a single polar flagellum at each end of the cell. They are motile and exhibit a corkscrew movement when viewed under the microscope. C. jejuni, C. coli and C. lari appear to cause 90% of reported human illnesses (but other species have, on occasion, been isolated from patients with diarrhoea, for example C. upsaliensis, C. fetus. These species are often called thermotolerant campylobacter as they grow best at 37-42°C, they cannot grow below 30°C, and therefore whilst they can be carried on chilled foods, they are not able to grow on them. It has been noted that older cultures of the organism become round in shape (the coccoid form), and these have been linked with a viable non-culturable state (i.e. the organism is still alive but cannot be cultured on laboratory media). Campylobacters are unusual as they do need some oxygen to grow, but they cannot tolerate the level of oxygen in air. Microbiologists refer to them as micro-aerophilic.

What does it cause?

Those that consume viable campylobacter in foods may suffer from campylobacteriosis. It has been estimated that the consumption of as few as 500 cells of the organism may be sufficient to cause illness. Once eaten, the incubation period is typically 2-5 days, but onset may be as long as 10 days after eating contaminated food. The illness usually lasts no more than one week but severe cases may persist for up to three weeks, and about 25% of individuals experience reoccurrences of symptoms. It is interesting that even though the immediate illness may be resolved in days, the organism may continue to be shed in faeces for up to 12 weeks.

The most consistent symptom of campylobacter infection is diarrhoea, which may contain blood. Other symptoms include fever, nausea, vomiting, abdominal pain, headache, and muscle pain.

The majority of cases are mild, do not require hospitalisation, and are self-limited. However, C. jejuni infection can be severe and life-threatening, infecting the blood and other organs.

As well as a simple gastrointestinal food poisoning, a number of long-term complications (known as chronic sequelae) can sometimes result from a campylobacter infection. Some people can develop a rare disease that affects the body's nervous system called Guillain-Barre Syndrome (GBS). This can begin several weeks after the diarrhoeal illness, may last for weeks to months, and often requires intensive care. Full recovery is common but some affected individuals may be left with mild to severe neurological damage. It is thought that 44% of cases of GBS are preceded by infection with campylobacter. Another chronic condition that may be associated with campylobacter infection is a form of reactive arthritis.

Where does it come from?

Campylobacteriosis is a zoonosis – its original source from which humans are infected will be animals. A wide variety of healthy domestic and wild animals can carry campylobacter. The bacteria usually live in the intestines as part of the animal's normal flora, and are shed in the faeces. With a few exceptions, campylobacter species do not cause any signs of illness in the animal host.

It is also possible for the organism to survive in raw water sources and food items such as raw milk. Because campylobacter has so many reservoirs in the environment, food products (especially poultry, beef, and pork) are at risk of contamination. Raw milk surveys have shown that campylobacter can occur, but is easily inactivated by pasteurisation. Produce may also become contami-

Continued on page 13

Continued from page 11
nated with campylobacter if exposed to contaminated water supplies or animal faeces during growth in the field, but such produce can also be contaminated in the kitchen environment, if it comes into contact with contaminated raw meat or meat juices.

A recent baseline survey on poultry, carried out by the European Food Safety Authority reported that campylobacter was detected in pooled caecal contents of broilers and on broiler carcases in all 26 of the participating EU Member States and the two participating non-Member States. Overall the prevalence of campylobacter-colonised broiler batches was 71% and that of campylobacter-contaminated broiler carcases was 76%. Member State prevalence varied from 2% to 100% and from 5% to 100%, for caecal contents and carcasses respectively.

About two-thirds of the campylobacter isolates from the broiler batches as well as those from the broiler carcases were identified as Campylobacter jejuni, while one-third was Campylobacter coli. A few were identified as other campylobacter species. A UK study in 2007-2008 and reported by the UK FSA noted a campylobacter prevalence at retail in the UK of 65%.

This forms a major challenge to those using poultry, as large quantities of the organism will be carried into food preparation areas, potentially resulting in risks of cross contamination within kitchen environments. The UK FSA is currently working with the poultry industry and food retailers to reduce levels of campylobacter on raw poultry and has set targets for required reductions over coming years.

The targets are for a reduction in the level of contamination in birds that are most highly contaminated (i.e. greater than 1000cfu/g campylobacter) from 27% in 2008 to 10% by 2015.

Campylobacter originates from the gastrointestinal tract of a variety of animals. From this source it can contaminate carcases, water, produce, milk, food preparation areas and human hands. Care when handling and preparing foods is essential to maintain control over the organism and reduce risks of infection.

The human cost

UK FSA figures suggest that campylobacter was responsible for more than 371,000 estimated cases of illness in England and Wales in 2009, resulting in more than 17,500 hospitalisations and 88 deaths. It has been suggested that campylobacter accounts for a third of the cost of foodborne illness in England and Wales, estimated at £583 million in 2008.

In the past campylobacter has always caused large numbers of isolated cases of food poisoning; however it has become apparent in the last two years that it is now responsible for increasing numbers of outbreaks of illness. Indeed, this organism has now overtaken Salmonella in the UK, as the single biggest cause of outbreaks of foodborne illness, much of which is due to issues surrounding the consumption of undercooked (pink) poultry pates and parfaits. Such items of undercooked poultry are a significant food poisoning risk.

Controls for campylobacter

Much intensive work has been undertaken by governments and food producers to try to reduce the levels of campylobacter in poultry. This has had varied effects in different countries, but in the UK we still have, as noted previously, around 65% of retail raw poultry containing the organism. However, this does not mean we have no effective controls. Production of industrially cooked poultry successfully reduces the risk of campylobacter in cooked products, by use of strict hygiene standards, proper cooking and separation of raw from cooked meat.

This regime is very successful and we rarely, if ever, see issues of industrially produced cooked poultry being linked to any cases of food poisoning. In smaller kitchens, careful control of raw poultry (and its packaging material) by ensuring that it (or its juices) do not contact ready to eat foods (RTE), food preparation areas or utensils used for RTE foods is essential. Proper cooking of raw poultry and poultry products (to centre temperatures of 70°C for two minutes) will eliminate viable organisms. Cooked poultry must then be stored in a way that prevents recontamination. The successful control of the organism in the kitchen involves no special requirements, just thought and good hygienic practices.

Methods of detection

Methods to detect campylobacter have been developed over many years and are detailed in various British Standards, European Standards, International Standards and in the USA, FDA and USDA procedures. Most of these methods are presence or absence tests (i.e. the results will determine if the organism is present in a known weight of product), and are based around the use of conventional broths and agars giving a result in around 3-5 days.

These methods usually require an enrichment step and isolation on one or more selective agar media. This will result in either a negative result, or a presumptive positive. As industry targets based around reduction in numbers of organisms have evolved, so have methods. There is now considerable interest in quantifying the number of campylobacter within samples, and this has led to the development of standardised methods based on direct plating which allow numbers to be counted. Again these enumeration tests give a presumptive result that has to be confirmed. This is achieved using biochemical tests, which can also be used to identify the species of campylobacter involved.

Over recent years a number of more rapid methods have been produced by commercial method producers, and these can now give results in 30-50 hours. Popular and well validated rapid methods include those based on immunoassay procedures and the polymerase chain reaction (PCR) technique. It is recommended that any company wishing to use a rapid method for campylobacter detection should only consider those that are well validated (for example by MicroVal, AFNOR, NordVal or AOAC) and they should also check that these methods work with their own ingredient/product types.

Conclusions

Although campylobacter were first observed in the late 19th century, they were only cultured in the late 1950s and their role in foodborne illness only became apparent in the 1970s. We now see them as the cause of more outbreaks and cases of foodborne illness than any other organism. The primary source of the organism is the animal gut. The main risk in human foods is contaminated raw poultry. However, as long as we understand the risk, it is possible to put in place adequate controls. Preventing contact between raw poultry (and its packaging) and Ready to Eat products, food preparation areas used for RTE foods, and utensils is key. The correct cooking of raw poultry and poultry products, and then storage to prevent post cooking contamination, is essential, as is good personal hygiene. All of these will considerably reduce the risk of campylobacteriosis. ■

✉ food.testing.admin@thermofisher.com

References are available from the author on request