Campylobacter – food industry impact and control strategies

Campylobacter is a bacterial genus widely distributed in the environment, its main reservoir being the gastrointestinal tract of domestic and wild animals. Birds are more prevalent due to their higher corporal temperature.

by J. Perez Marin and M. Somolinos Lobera, OX-CTA SL, Spain. www.grupoox.com

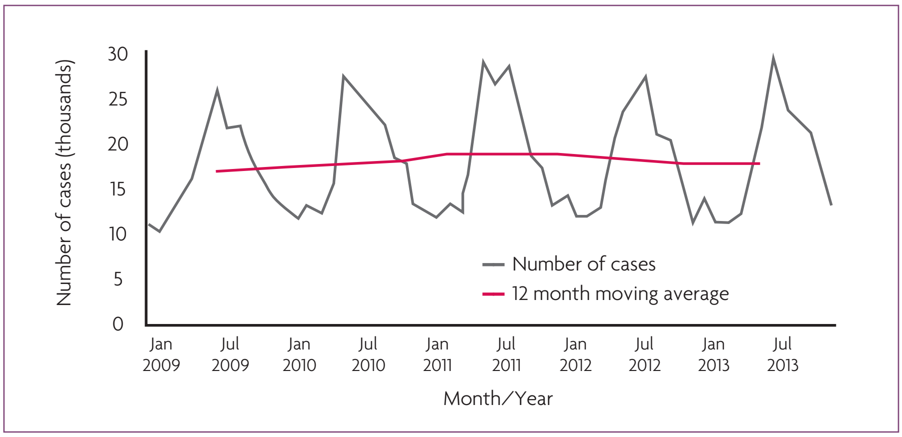


Fig. 1. Trend of campylobacteriosis incidence in EU 2009-2013 (EFSA, 2015).

The genus Campylobacter includes at least, 25 species, C. jejuni being responsible for more than 95% of diagnosed cases of campylobacteriosis and C. coli the most frequently detected in humans.

At present, campylobacteriosis is the most commonly reported zoonosis (disease transmitted to humans by animals or products from animal origin) in the European Union, with 220,209 cases in 2011 (EFSA, 2013). No statistically increasing or decreasing trend in the number of cases was observed when analysed by month over the last five year period (Fig. 1).

Nevertheless, EFSA affirms that less than 10% of campylobacteriosis cases are notified. Thus, it is calculated that every year in the European Union around nine million infections caused by campylobacter occur, which represents an approximated cost of €2,400 million.

A similar situation can be observed in the United States, where campylobacter is one of the leading causes of diarrhoeal illness. Active surveillance through the Foodborne Diseases Active Surveillance Network (FoodNet) indicates that about 14 cases are diagnosed each year for each 100,000 inhabitants. Many more cases go undiagnosed or unreported and campylobacter is estimated to affect over 13 million persons every year. Although it does not commonly cause death, it has been estimated that approximately 76 persons with campylobacter infection die each year (CDC, 2013).

Most cases of campylobacteriosis in humans are associated with consumption of products of animal origin.

The infective dose of campylobacter is relatively small. Ingestion of less than 500 micro-organisms (an amount that can be easily found in one drop of sauce) may develop the disease. In spite of such a low infective dose and the ubiquity of campylobacter in the environment, most cases occur as isolated events. However, some zoonotic outbreaks have also been documented all over the world (Washington State Penitentiary, Kinkin Dairy Raw Milk, etc). Anyone is vulnerable to campylobacter, but children, old people and immune-compromised people are more likely to contract the illness.

The incubation period ranges from 2-5 days, but occasionally can extend for longer than 10 days (OMS, 2011). Most common symptoms of campylobacter infections are diarrhoea, abdominal pain, high temperature, headache, nausea and/or vomit. Diarrhoea persists for 3-6 days, but abdominal pain and sick feeling can persist for longer.

Taking into account the importance of this public health issue, several control and prevention strategies have been put in place from the primary production to the final consumer, including every single step of the food chain (food industry, distributors and catering industry).

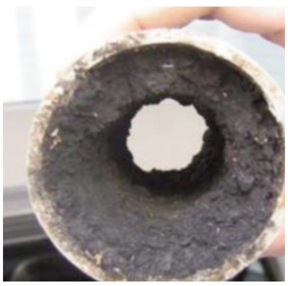
At the same time, Public Health Organisations are promoting the implementation of different regulations and measures aimed at the responsible use of antibiotics, both at human and veterinary medicine in order to avoid the development and diffusion of resistant strains of several food-borne pathogens, campylobacter included.

Even if the situation is still far from optimal, positive improvements have been observed. For example, in the UK since the FSA established the 'Acting on Campylobacter Together' campaign, the

Continued on page 9

Transversal section of pipes and conduits with biofilm.





Continued from page 7
UK-wide survey of campylobacter contamination of fresh chicken at retail results for the first quarter of 2015 showed a decrease in the number of birds with the highest level of contamination, from the same months last year. The new data shows 15% of chicken tested positive for the highest levels of contamination, down from 22% in July to September 2014.

Campylobacter was present on 76% of chicken samples, down from 83% in the same months of last year (FSA, 2016). This significant improvement served to underscore the importance of continuing to promote all the measures intended for control and prevention.

Biofilm as a protective barrier

Chicken meat and derivatives are the main source of transmission of campylobacter to humans. This fact is due to the great amount of poultry flocks that are positive to this micro-organism at slaughter date, which causes raw chicken meat contamination during the slaughter process.

A high percentage of the birds that arrive at the slaughterhouse excrete campylobacter in their droppings. Taking this into account, it is difficult to avoid the contamination of poultry carcases and slaughterhouse equipment. On the other hand, once the infection establishes in poultry, campylobacter multiplies very fast, reaching infective doses very soon.

Taking into account that most poultry carriers are asymptomatic, the diffusion of the infection through contaminated water and contact with faeces is very frequent.

This fact, together with the high intensification level of poultry production at this moment, make campylobacter an infectious agent that is very difficult to control.

Although C. jejuni is the main cause of infection in humans transmitted by animal origin products, outside a host, in the environment, this micro-organism is not very resistant. In order to survive under adverse conditions, some pathogens develop the capability of forming organised structures called biofilms. A biofilm is a complex community of micro-organisms that grows inside an organic polymeric extracellular matrix which allows them to adhere to alive or inert humid surfaces. It has been demonstrated that biofilms act as protective barriers against desiccation, disinfectants and antibiotics.

Moreover, they facilitate nutrition and genetic exchanges. As a consequence, common disinfectant methods and antibiotic products are very often non-effective against micro-organisms structured in biofilms.

Campylobacter is able to form biofilms in aquatic environments and also in other surfaces. The environment created inside the biofilm offers the optimal microaerophilic conditions for C. jejuni development. It has been shown that this micro-organism is capable of surviving one week at 10°C inside a biofilm with limited nutrient level. Despite its sensitivity to atmospheric conditions (presence of oxygen), campylobacter is able to develop biofilms more quickly under aerobic conditions (20% O_2) than under microaerophilic conditions (5% O_2 and 10% CO_2). Thus, biofilm may act as a reservoir of campylobacter viable cells.

Fortunately, biofilm formation along the food chain may be controlled by the implementation of intelligent biosafety management systems. These work programs are essential in order to prevent campylobacter contamination.

Biofilm control

Biofilm tridimensional structure is involved in their resistance to disinfectants and other chemical products. The thicker and older the biofilm, the higher its resistance. As a consequence, the effectiveness of a chemical product in order to eliminate biofilm will be directly linked to its capability to disorganise extracellular matrix.

Hydrogen peroxide, due to its mechanism of action, guarantees the complete destruction of extracellular matrix that provides resistance to biofilm. At common recommended dosage for water treatment, it eliminates biofilm and it does not lead to toxicity, or corrosion problems.

Peracetic acid is a very powerful chemical oxidant that may be stabilised with hydrogen peroxide resulting in peroxyacetic products. These types of mixtures are 100% biodegradable and have demonstrated a great effectiveness in eliminating biofilms even under hard conditions. Having in mind this information, the optimal work protocol in order to control biofilm requires continuous water treatment using products formulated with stabilised hydrogen peroxide (Grupo OX recommends the use of OX-AGUA 2G) and periodic cleaning and disinfection treatments of surfaces and water distribution systems using peroxyacetic products (Grupo OX recommends the use of OX-VIRIN).

To avoid toxicity risks and guarantee long shelf life of materials and equipment, it is necessary to work with stabilised products integrated in a complete biosecurity work program. Grupo OX is specialised in offering integral solutions adapted to specific necessities achieving a very interesting return on investment.

Conclusions

The presence of biofilm throughout the food chain is a very important problem closely related to food safety. It has been proven that campylobacter is able to grow creating biofilms. The characteristics of this particular way of microbial growth leads to the necessity of implementing specific cleaning and disinfection processes in order to overcome biofilm protective barriers.

Biofilms can be eliminated by the establishment of specific biosafety work protocols applied regularly. Nevertheless, the difficulty in eradicating well instituted biofilms, makes prevention the most intelligent control strategy.

The application of peroxyacetic products in order to disinfect surfaces and water distribution systems during non-productive periods combined with a continuous water treatment with stabilised hydrogen peroxide based products, are key factors in order to develop a complete strategy to control campylobacter. ■

References are available from the author on request